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A Practical Decision Guide for Integrating Digital Applications and Handheld Devices into Advanced Individual Training

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14. ABSTRACT *(Maximum 200 words)*:

The objectives of this research were to (1) identify and evaluate lessons learned from selected Connecting Soldiers to Digital Applications (CSDA) pilot tests for the development, integration, and sustainment of digital training applications and handheld devices in Advanced Individual Training (AIT), and (2) develop a practical decision guide for key decision makers determining the utility of digital applications and mobile technologies for AIT and developing metrics for accessing their impact on training. A literature review was conducted and data were collected from subject matter experts who had participated in CSDA pilot tests. Results were organized into 10 factors and 35 associated subfactors related to the topics of training methods and delivery, human and contextual factors, and hardware and infrastructure capabilities and constraints. A decision guide was developed to help inform key decision makers about factors associated with the use of digital applications and handheld devices in training.

15. SUBJECT TERMS

Digital applications, handheld devices, mobile devices, mobile learning, self-directed learning

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A PRACTICAL DECISION GUIDE FOR INTEGRATING DIGITAL APPLICATIONS AND HANDHELD DEVICES INTO ADVANCED INDIVIDUAL TRAINING

EXECUTIVE SUMMARY

Research Requirement:

The objectives of this research were to (1) identify and evaluate lessons learned from selected Connecting Soldiers to Digital Applications (CSDA) pilot tests for the development, integration, and sustainment of digital training applications and handheld devices in Advanced Individual Training (AIT), and (2) develop a practical decision guide for key decision makers determining the utility of digital applications and mobile technologies for AIT and developing metrics for accessing their impact on training.

Procedure:

A literature review was conducted to understand the factors that need to be considered when integrating digital applications and handheld devices into training, as well as identifying potential best practices relevant to military training settings. To gain a more practical perspective, subject matter experts were asked to share their experiences with the use of digital applications and handheld devices in training. The input from these interviews and focus groups was then analyzed in order to identify a final list of factors and subfactors that should be considered as part of the process for deciding whether to and how to integrate digital applications and handheld devices into AIT. These factors and subfactors framed the basic logic structure for the decision guide.

Findings:

Results from the literature review and interviews and focus groups identified 10 factors and 35 associated subfactors that needed to be considered when integrating digital applications and handheld devices into training. These factors and subfactors represented key issues in the areas of training methods and delivery, human and contextual factors, and hardware and infrastructure capabilities and constraints.

Utilization and Dissemination of Findings:

The findings of this research, in the form of a Practical Decision Guide, can be used to inform key decision makers on the factors that should be considered to determine if digital applications and handheld devices are appropriate for their AIT program(s). A copy of the final guide was provided to the US Army Combined Arms Center (CAC), Fort Leavenworth, KS, and TRADOC Deputy Commanding General for Initial Military Training (DCG-IMT), Fort Eustis, VA.

A PRACTICAL DECISION GUIDE FOR INTEGRATING DIGITAL APPLICATIONS AND HANDHELD DEVICES INTO ADVANCED INDIVIDUAL TRAINING

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Introduction

Recognizing that more new Soldiers are entering the Army with a familiarity and comfort with interactive technologies rarely seen in previous generations, the Army has been exploring how to exploit emerging interactive, handheld technologies and digital applications to enhance the effectiveness and efficiency of Soldier training. To this end, the US Army Capabilities Integration Center (ARCIC) sponsored a number of pilot tests supporting the Connecting Soldiers to Digital Applications (CSDA) initiative. These pilot tests focused on examining the utility of employing mobile, handheld technologies and gaming solutions to bridge the gap between Soldier learning and training as a function of time, resources, and instructor contact ratios.

While metrics and strategies were developed to assess the utility of each of these pilot efforts, there was no plan in place to build upon these largely technological assessments to provide practical guidance for Advanced Individual Training (AIT) commanders and training developers considering the development and integration of these applications and technologies in their training programs. Such guidance, based upon lessons learned from these pilot efforts and best practices from blended learning theory and practices, would provide training commanders and developers with a sound foundation for determining how best to employ these emerging technologies within their training programs.

This research was conducted to create a decision guide to aid decision makers in designing and implementing digital applications and mobile devices into AIT. A literature review was conducted to identify best practices and lessons learned from previous research. Additionally, a data collection was conducted to build on the findings of the literature review and identify the factors that are important to consider in designing and implementing digital applications and mobile devices in AIT. Finally, the product of the literature review and data collection yielded a comprehensive decision guide that was evaluated by subject matter experts to test its quality and make additional refinements.

Literature Review

The objective of this literature review was to identify existing and emerging learning and, more appropriately, training theories, strategies, and practices related to integrating mobile learning technology into AIT. Literature on learning and training theories and mobile device training lessons learned was used as a foundation for developing a practical decision guide for AIT commanders to determine how and when to most effectively integrate digital applications and mobile technologies into training.

Military and nonmilitary resources were identified in this review. Defense Technical Information Center (DTIC), PsycINFO, and Google Scholar were used to identify resources. Additionally, the US Army Training Concept 2012-2020 (Pam 525-8-3, 2011), and US Army Learning Model (ALM) (PAM 525-8-2) were reviewed to describe related aspects of the

emerging Army training environment, and the role of mobile learning within the future training context. Conference proceedings from the Interservice, International Training, Simulation and Education Conference from 1990-2010 and from the World Conference on Mobile and Contextual Learning (2001-2011) were also reviewed.

The need for an integrated training environment. The operational environment (OE) and ARFORGEN cycle presents challenges that must be understood in order to develop more effective training methods. The Army Training Concept (2011) described the challenges and respective actions that must be taken to train Soldiers to conduct Full Spectrum Operations in an era of persistent conflict. The state of persistent conflict and operational tempo presents a challenge to effectively and efficiently train during the reset phase of ARFORGEN.

This challenge is exacerbated by the lack of an integrated training environment (ITE). The Army Training Concept (2011) identified ITE as the "Linkage of selected training aids, devices, simulators, and simulations (TADSS), infrastructure, mission command systems (MCS), and knowledge management systems, and a training framework to approximate the conditions of the operational environment for training and education for full-spectrum operations in operational, institutional, and self-development training domains" (p. 96). The overarching goal of ITE is to integrate these domains. An ITE is a means to overcome challenges posed by the OE and an aggressive training timetable. In an ITE, training requirements and objectives are met by effectively connecting the Army learning domains to form a network and then connecting leaders to that network. The institutions become learner-centric by developing training that can be accessed by Soldiers when they need it (PAM 525-8-3, 2011).

According to the Army Training Concept (2011), the integration of the training domains can be achieved through effective development and implementation of resources. These resources should be easily accessible to Soldiers and create a seamless network across training domains. Specifically, mobile learning devices were identified as a resource capable of meeting OE challenges and fulfilling training objectives (PAM 525-8-3, 2011).

The Army Training Concept described the Army's vision for the future training context. AIT, as a part of institutional training, has needed to continue working to adapt to this context in order to meet the Army's overarching goals in a more learner-centric environment. The role of mobile devices in AIT within this evolving training context is discussed in the following section.

Mobile learning within the Army's future training context. The Army Training Concept described the potential for mobile training devices to provide instrumental support in creating an ITE. The basic rationales for using mobile learning devices in training are access and portability. First, mobile devices provide a link between the operational, self-development, and institutional domains. PAM 525-8-3 (2011, p, 101) stated that mobile training devices "provide access to learning content, courseware, and career data, as well as performance support applications; can be used to transmit information that must be captured, analyzed, and important lessons rapidly disseminated to those who need to know and can take action" (PAM 525-8-3, 2011, p. 101). The centers of excellence (CoEs) and schools are hubs for information and training. By integrating mobile training devices within their training environments, Army

Soldiers and civilians will be able to directly access Army networks to meet training needs (see PAM 525-8-3).

The second basic attribute of mobile training devices is portability as mobile devices allow learners to not be bound by location (PAM 525-8-3, 2011). For example, Soldiers can use the information or data accessed through these devices as a reference or tool in conducting tactical operations, completing administrative actions, enhancing their individual knowledge and skills on specific tasks, or managing their careers. Most importantly for AIT environments, Soldiers and instructors can use mobile learning devices to enhance the student centered aspects of classroom training, provide a means to fully exploit training time for every Soldier, and better connect classroom instruction to field training.

Mobile learning can be an effective method for delivering training in AIT and can help to create an ITE. To fulfill their role in the future Army Training Concept, the CoEs and schools need to appropriately translate curricula and resources to a mobile learning environment and augment training with mobile instruction. Thus, this literature review considered the implementation of mobile learning in AIT and future training contexts by addressing the following questions concerning the implementation of mobile learning in AIT.

- What are the AIT learning environment features that are most critical to AIT training design?
- How can blended learning theories be applied to understand the design components related to AIT training?
- What learning theories and instructional practices are most relevant to AIT training and how could they be used to enhance AIT training?
- What are the best practices and lessons learned for designing, developing, and implementing AIT training using mobile devices?

AIT training context. It is valuable to acknowledge distinctions between general education, professional development, and technical training when examining AIT training content. As Bonk and Wisher (2000) pointed out, there are "fundamental differences in the goals, outcomes, and eventual application of the underlying instruction" (p. 3) between education and training. "AIT continues Soldier development along with basic competencies for military occupational specialty (MOS) skills. It is often considered as a trade school where learning individual basic job skill sets are acquired" (TRADOC Pam 525-8-2, 2011, p. 46). While AIT includes the ongoing development of Soldier values and general skills, the primary focus of AIT is on MOS specific technical skill, as part of the Army's integrated training strategy. AIT schools vary in length from six weeks to over 1 year, and comprise a vast number of different occupations, training content, training objectives, training contexts, equipment, and practice opportunities. Therefore, special consideration must be given to determine optimal uses for mobile learning technology across such a wide array of training situations.

In addition to the focus on task-specific skills, AIT is limited in time and relies heavily upon an institutional environment and, more often than not, on Soldiers interacting with highly technical equipment, systems, and environments. The goal of AIT instruction is much more similar to mastery learning than general knowledge education and professional development.

Mastery learning is based upon the notion that learning is a function of time (Bloom, 1974) and based upon some criterion of learning (Carroll, 1963). AIT courses typically, if not universally, require criterion-referenced proficiency tests to ensure skills are being learned, which can be applied under standardized conditions in some observable, quantifiable way to an established standard. Ensuring proficiency to an established minimum level is a critical component of any position that involves a high danger element (e.g., tank gunner, medical professional, infantry Soldier, etc.).

When examining AIT, it is also valuable to consider different MOSs. All MOSs require certain knowledge and skills to perform effectively. However some MOSs have significant physical and psychomotor aspects that are not required of other MOSs. For example, vehicle, weapon, or health care specialists must perform physical skills to a level of proficiency on real equipment that other MOSs may not. During AIT, these MOSs require proficiency tests on the actual equipment (or very high fidelity simulations). Other MOSs that emphasize using primarily cognitive and information processing skills such as intelligence, information technology, and other service and support functions may not require as much time spent on qualifying equipment. Therefore, the nature of the content and the interaction with equipment may limit the usefulness of mobile devices for certain training content.

Several categories of learning theories and learning and instructional practices are especially relevant for considering effective implementation of mobile devices in AIT. These theories and practices are reviewed in the following sections.

Learning Theories

Learning theories represent a wide array of ideas, models, and concepts related to how children (pedagogy) and adults (andragogy) acquire knowledge and skills. There is no consensus on which learning theories are the most robust or relevant to specific types of learning. Though no one theory stands above the others, all of the learning theories discussed herein provide potentially valuable methods for executing effective training. Thus, knowledge of the learning theories can be exploited to apply aspects of each theory in the design of effective training with mobile devices.

An understanding of the distinction between learning theories and instructional practices is important in interpreting the role of a learning theory in determining the utility of mobile learning and integration of mobile technology into AIT. Learning theories establish the foundation for why an instructional practice may or may not be effective. For example, operant conditioning, a theory of behaviorism, would posit that instructional practices that provide a timely reinforcement for appropriate student actions in response to certain stimuli would be more successful than instructional practices that do not provide such reinforcement. While the theory may support specific practices within the instructional system, it is unlikely to be the sole source for the development of training content related to a course of instruction. In reality, several, if not most, learning theories have some relevancy to the traditional systems approach to training and military training course design. This review attempts to examine those learning theories that are most pertinent to improving learning outcomes related to mobile and blended learning applications and technologies in technical training.

General learning theories. The following theories and practices were selected for review based upon their contribution to explaining various aspects of learner motivation and reinforcement, learning content and context, and the learning process. General theories are first described and then more specific instructional practices related to the use of blended and mobile learning techniques are provided. Four prevailing theories[1] of learning are described: behaviorism, cognitivism, constructivism, and andragogy. In some cases, instructional practices may be closely associated with certain learning theories, such as self-directed learning and andragogy, however, in many cases these practices may support multiple theories.

Behaviorism and operant conditioning. Behaviorism as a learning theory has a long and rich history incorporating perspectives from Pavlov, Watson, Hull, Spence, and most notably Skinner (see Moore [2011] for a recent overview). For the sake of brevity, this review focuses on the role of operant conditioning in learning and training. Operant conditioning can be extended to learning theory in terms of the reinforcement of learning behaviors. Simply stated, operant conditioning maintains that behaviors that are reinforced will be associated with other, conditional stimuli. Operant conditioning is distinguished from classical conditioning in that it deals with voluntary behavior. However, even classical conditioning is relevant for understanding certain aspects of military training, particularly motor skills development (Lee & Schmidt, 2005). Coaches and athletes often refer to muscle memory, which develops with repeated physical motion of patterned actions. The connection between stimulus and action is often made in milliseconds and thought is nearly eliminated. As the repetition and reinforcement of these actions leads to increased proficiency, confidence also builds.

Both operant and classical conditioning could be considered in the application of mobile devices in Army training, as they serve to more efficiently connect the Soldier to the stimuli, responses and reinforcement associated with trained behaviors and actions. Among the issues related to mobile devices for which operant and classical conditioning learning theories are applicable are the ability of the devices to provide the necessary cues for proper student response, the ability of the devices to provide appropriate and timely reinforcement of actions, and the ability of the devices to provide cues related to improper behaviors or actions (see Naismith, et al., 2004 for more details). In addition, the opportunities for extended practice and instructor independent (as well as integrated) reinforcement seemingly represent considerable value-added capabilities from the application of mobile devices within AIT environments from these learning theory perspectives.

Cognitivism. Cognitivism, as a learning theory, involves a broad set of sub-theories that consider human thought processes and the functioning of memory, information processing, and knowledge formation as paralleling that of computer processing. Mayer's theory of multimedia learning (Mayer & Johnson, 2008) could have importance to the design of learning applications, as it advocated replacing visual text with spoken text (the modality effect) and adding visual cues relating elements of a picture to the text (the cueing effect) to increase the effectiveness of

[1] Connectivism (Seimens, 2005; Downes, 2005) has been proposed as a new theory of learning particularly suited for determining the role of technology in learning. However, the lack of significant research or even specific practical applications related to Connectivism relegate it to more of a learning perspective than a theory for discussion in this review.

multimedia instructions in terms of better learning results or less mental effort spent. A recent meta-analysis by Adesope and Nesbit (2011) demonstrated that students receiving spoken-written and written-only presentations did not exhibit performance differences, but students who experienced spoken-written presentations did outperform those that received spoken-only presentations. Mayer's theory of multimedia learning and the results of Adesope and Nesbit's meta-analysis suggest that written presentation of learning material combined with spoken instruction can increase the effectiveness of instruction, specifically in comparison to types of instruction that rely solely on spoken instruction. These findings are relevant to AIT instruction in two ways. First, applications should not rely solely on spoken forms of instruction or audio to deliver content, but rather content should include both spoken and written forms of instruction. Second, mobile devices could aid in AIT training settings that typically rely solely on verbal or spoken forms of instruction by providing supplemental text to accompany and support the verbal and spoken instruction.

The application of cognitivism to training is intended to reduce the mental load on students and assist in organizing the knowledge and skills to be learned through the use of multiple sources of information, but not such that they overwhelm the processing capacity of the individual. There are several instructional practices that explore different types of cognitive strategies and strategies that engage the participant in active learning, such as learning from others (Gibbs, 1999), tutoring others (Merrill, Reiser, Merrill, & Landes, 1995), self-regulation (Zimmerman, 1989), instructional scaffolding (Vygotsky, 1978). Mobile devices provide an additional media source for students to search, receive, and experience learning content, practice methods, and feedback on performance. The applicability of cognitivism to the use of mobile devices in AIT is pervasive and complex, and should be considered early in the media selection process such that device use is consistent with learner background, capabilities, and content integration requirements.

Constructivism. Constructivist theories propose that knowledge is actively constructed by the individual learner and knowing is an active and adaptive process that serves to organize the individual's experiential world (Mayer, 1992; Hendry, 1996). Learners bring their past experiences to the learning setting which establishes a baseline for gaining more knowledge and building upon this baseline. Constructivism asserts that the role of learning (and training) is to allow the learner to discover how additional knowledge and experience fits into their existing cognitive sets or mental representations of reality. Constructivism is associated with many instructional practices, including self directed and self regulated learning, collaborative learning, and goal setting. Two principal considerations regarding the application of constructivism and the use of mobile devices are implied. First, the way in which instructors use mobile devices to facilitate construction of learning by the learner is important as particular approaches may foster or hinder various goals, and it is important to assess which approaches work best for which goals. Second, the degree to which learners can use the mobile device to structure, re-organize, and experience emerging learning content will also aid in the long term use of the devices and transfer of knowledge to job tasks and performance contexts.

Andragogy. Andragogy, most often associated with Malcolm Knowles, refers to adult learning principles and more specifically to the notion that adult learners prefer learning methods that allow them autonomy and the ability to direct their own learning activities (Hiemstra, 1994).

Andragogy stipulates that: (1) adults need to know why they need to learn something, (2) adults need to learn experientially, (3) adults approach learning as problem-solving, and (4) adults learn best when the topic is of immediate value. In practical terms, andragogy means that instruction for adults needs to focus more on the process and less on the content being taught. Strategies such as case studies, role playing, simulations, and self evaluation have been found as most useful with adult learning. The importance of andragogy as a theory for the implementation of mobile and digital devices into Army training is the emphasis on the learner to self-direct, self-manage, and self-motivate toward effective learning content and practice (Garrison, 1997). These principles are reflected in the Army's self-development pillar of the education process.

Andragogy, self-directed learning, and other self-learning motivation theories have extensive implications related to the use of mobile devices in all Army environments, given ALM and its implications for extending training and learning beyond the classroom and over a Soldier's entire career. The degree to which mobile devices will be used for learning purposes, given these devices allow individuals to choose when, where, and even how they want to learn, is controlled by the individual. Therefore, it will be important to recognize individual differences in motivation, understanding, and rewards related to self-learning and the ability to direct one's own learning. It will not simply be enough to train Soldiers on the use of the devices without having some information related to the potential impact that lack of motivation and intrinsic motivation play in individual learning effectiveness.

Learning and Instructional Practices

Perhaps more relevant to the application of mobile and digital devices to AIT than learning theories are the instructional practices related to these theories and the research on their effectiveness and applicability to technical training (or at a minimum work-related learning). The following instructional practices, some of which are often described as theories themselves, were examined for relevancy to AIT and the use of mobile technology.

Blended learning. In an ARI report, Tucker (2010) identified several potential approaches to mobile learning for Army institutional training. Tucker's purpose was to identify literature that would be helpful for incorporating smartphones into Army training. Tucker suggested that a blended approach should be taken to better exploit the advantages of mobile learning within institutional training. A blended approach would add to the value of current instruction by applying mobile learning pedagogies/andragogies and leveraging the capabilities and tools of mobile devices (e.g. applications, camera).

Blended, hybrid, and e-learning have been described as referring to an evolving set of definitions related to a combination of: face-to-face and online instruction, media and technologies and pedagogical methodologies (Sharma, 2010). Regardless of the components of blended learning, Zhao (2008) recommended that blended e-learning should include well-designed and optimized learning delivery methods, as well as specific objectives, learning events, tasks, and purposes. Seemingly, any instructional system that includes methods other than classroom-based, instructor-led components may satisfy the definition for blended learning. Further, classroom-based, instructor-led training can be combined with online and technological components to create a blended learning experience.

Yoon and Lim (2007) provided an overview of blended learning research findings and offered a conceptual framework of blended learning that included a strategic focus on learning objectives and the available technology. Tsai (2011) proposed and found attitudinal support for a model of hybrid e-learning that contained elements of scenario (realistic examples), collaborative (student-to-student), and scaffolding (supported by others) aspects.

Carman (2005) applied constructivist (i.e., knowledge is actively constructed), cognitivist (i.e., learning involving human thought processes), and performance support learning theories to identify the following five key ingredients to blended learning design.

1. Live Events: Synchronous, instructor-led learning events in which all learners participate at the same time, such as in a live "virtual classroom."
2. Online Content: Learning experiences that the learner completes individually, at his or her own speed and on his or her own time, such as interactive, Internet-based or CD-ROM training.
3. Collaboration: Environments in which learners communicate with others, for example, through e-mail, threaded discussions, and online chatting.
4. Assessment: A measure of learners' knowledge. Pre-assessments can come before live or self-paced events, to determine prior knowledge, and post-assessments can occur following scheduled or online learning events, to measure learning transfer.
5. Reference Materials: On-the-job reference materials that enhance learning retention and transfer, including checklists, diagrams, decision aids, etc.

The empirical literature on blended learning environments has supported the effectiveness of blended learning in some domains. Improved learning outcomes under blended learning conditions (online with traditional classroom) have been demonstrated by Boyle, Bradley, Chalk, Jones and Pickard (2003) and Dowling, Godfrey, and Gyles (2003). In addition, Starenko, Vignare, and Humbert (2007) described the results of an earlier study showing student satisfaction increased under blended learning conditions. It is important to note that e-learning has also been associated with negative consequences, including a steep learning curve for the technology involved and procrastination with asynchronous learning (Yoon and Lim (2007). Results regarding strictly online or distance learning courses without blended components are mixed. For example, Reasons, Valadares, and Slavkin (2005) found that students participating in an online course outperformed those in both classroom only and blended (classroom and online) conditions. However, Stein (2004) found that more important than whether or not blending was a component of a course was the level of structure related to objectives, assignments, deadlines, and teacher expectations of dialogue and student interaction.

Hsu and Hsieh (2011) conducted a cross sectional study of learner demographics (age, previous school, months working, class rank), learning behaviors (time spent online and number of web talks), and self reported learning performance (case analysis attitude scale [CAAS], case analysis self-evaluation scale [CASS], metacognition scale [MS], and blended learning satisfaction scale [BLSS]) with ethics course scores. Frequency of online dialogues, time spent on the internet in minutes, and CAAS score were found to be positive, significant predictors of learning outcome. The learning outcome was the final course score that was comprised of overall performance in online scenario discussion, classroom participation, team debate, and

group report. Findings imply that both time and attitudes toward the learning method affect learning in blended courses.

The applicability of blended learning theories and practices to the use of mobile devices in AIT essentially involves when and where the devices will be used. That is, will they be used for in-class only purposes or will they be used by students outside the classroom, including breaks during the workday, during leisure time, and possibly even to access other institutional training when remote from the training location? In determining the utility of using mobile devices in blended learning, it is important to consider learner familiarity and other attitudes toward the devices, instructor attitudes, and how well learning objectives are structured into the learning activities.

Mobile learning. Although somewhat dated for a quickly evolving field, Naismith, Lonsdale, Vavoula, and Sharples (2004) provided an extensive literature review on the learning theories and empirical research related to mobile technologies and learning that is relevant for the current effort. The authors identified the following as key considerations when integrating mobile technologies into learning and training:

- Context – the learner's desire for anonymity and privacy may affect learning effectiveness,
- Mobility – consideration of the learner's ability to engage in activities not associated with the learning objectives,
- Learning over time – consideration of the how learning will be measured and recorded in mobile environments,
- Informality – students may perceive the use of technology to threaten their existing social networks, and
- Ownership – students may want more control over their devices in the classroom than feasible during learning and training.

O'Malley, Vavoula, Glew, Taylor, Sharples, and Lefrere (2003) provided guidelines for learning in mobile environments that included an overview of learning theories and their influence on learning technologies. The authors provided examples of specific technology applications under behaviorist, constructivist, situated, collaborative, informal/lifelong, and instructor supported theoretical approaches. A set of 27 guidelines were then identified that include cost, usability, input, output, learner involvement, roles, and other aspects that assist users in applying mobile devices to improve learning outcomes. Each of the guidelines is pertinent to the integration of mobile devices into Army AIT and were considered as appropriate for input into the final product.

A recent article by Keskin and Metcalf (2011) proposed 15 different theories as applicable to mobile learning and provided definitions, focus, and examples with mobile technologies in support of their proposal. However, it is debatable as to whether what the authors identified as theories (e.g., context awareness learning, collaborative learning, informal learning) may be better categorized as instructional practices or strategies rather than theories. The authors did not provide any specific research supportive of these theories and how they were applicable to integrating mobility into learning practices.

Sharples, Taylor, Vavoula (2005) presented a framework for analyzing the relationship between mobile technology and learning as an adaptation of Engestrom's expansive activity model (Engestrom, 1987). This framework posited learning as an activity system that both supports and constrains the learner in their development. A semiotic layer consists of learner object oriented actions that are mediated by cultural tools and signs (language, etc.). A technological layer consisting of tools and devices serves to aid learners in making connections, aiding recall, and reflection. Sharples et al. (2005) noted that "Learning occurs as a socio-cultural system, within which many learners interact to create a collective activity framed by cultural constraints and historical practices" (p. 7).

Yen and Lee (2011) used classroom instruction, web-based, and mobile learning scenarios on a problem solving exercise and identified three types of learners through content and cluster analysis of student learning process data: a hybrid-oriented group, a technology-oriented group, and an efficiency-oriented group. Learners in the hybrid-oriented group used the classroom, mobile, and web scenarios approximately equally and followed instructor's teaching procedures passively. Students in the technology-oriented group spent the majority of their time using mobile and web technologies but they displayed lower problem solving abilities including a lack of understanding and planning difficulties. The efficiency-oriented group performed better on problem solving tasks than the other groups and spent more time on the assigned task and time monitoring the learning process. This research has implications for examining individual differences in understanding and use of blended technologies.

Mobile learning theories are important to consider in determining the applicability of mobile devices in AIT as they specify student, training context, mobile device, and training objective characteristics to consider when evaluating mobile device utility in a particular context. Many of the value aspects related to mobile learning theories have already been incorporated in the Army Learning Model from a general utility perspective. However, decisions related to the particular utility of a device to a specific course or objective will benefit from close examination of these characteristics as they relate to the specific learning context. For example, some training objectives related to weapon firing accuracy may not benefit from the use of mobile devices because they do not provide the necessary haptic fidelity related to trigger or firing mechanisms. Yet, a mobile device may be valuable for other objectives related to weapon sighting or support position.

Self directed learning and self regulated learning. Knowles (1975) defined self-directed learning (SDL) as "a process in which individuals take the initiative, with or without the help from others, in diagnosing their learning needs, formulating goals, identifying human and material resources, choosing and implementing appropriate learning strategies, and evaluating learning outcomes" (p. 18). There has been extensive interest in SDL and considerable attention given to measuring self-directed learner readiness (Guglielmino, 1978; 1989). However, the empirical findings regarding the effects of SDL on learning outcomes are somewhat mixed (Chou & Chen, 2008, as reported in Deyo, Huynh, Rochester, Sturpe, & Kiser, 2011).

Maurer, Weiss, and Barbeite (2003) found that individuals who are oriented toward their own professional development tend to:

- Have prior experience with development in the same area,
- Perceive themselves as possessing the qualities needed for learning,
- Have social support for development at work,
- Are involved in their jobs,
- Have insight into their career,
- Believe in the need for self development, and
- Believe in their abilities to develop skills and receive benefits from development.

Murad, Coto-Yglesias, Varkey, Prokop, and Murad (2010) conducted a meta-analysis of 59 studies that compared SDL with traditional teaching methods for health professionals. The results revealed that the use of SDL was associated with a moderate improvement in knowledge-based outcomes compared with didactic instruction, but there were no significant differences between the two with respect to skill and attitude-based outcomes. The study also found SDL to be more effective when learners were involved in identifying their own learning resources.

Closely related to the concept of SDL is that of self-regulated learning (SRL). Self-regulation, also referred to as metacognition (self-regulation is sometimes conceptualized as broader than cognition) is defined as an individual's awareness, knowledge, and control over his or her cognitions and behaviors (Flavell, 1979; Martinez, 2006), and includes planning, monitoring, and revising behavior (Brown, Bransford, Ferrara, & Campione, 1983). SRL theory posits that the learner manages affective, cognitive, and behavioral processes throughout a learning experience to reach desired goals. A recent meta-analysis of the self-regulated literature specific to work-related learning (Sitzmann & Ely, 2011) revealed that goal level, persistence, effort, and self-efficacy were the most significant predictors of learning, after controlling for the effects of cognitive ability and pre-training knowledge of the subject matter. Equally as important was the finding that planning, monitoring, help seeking, and emotional control did not provide significant contribution to the prediction of learning in self-regulated contexts.

Loyens, Magda, and Rikers (2008) examined SDL in problem-based learning and compared SDL and SRL theories. The authors proposed the primary distinction between the two is the role of the learner in identifying and evaluating the reference material and instructional content. The tenets of SDL suggest that learners are responsible for identifying what is to be learned, whereas in SRL an instructor or other guide could identify what is to be learned (Loyens et al.). The origin of the learning experience is of less significance in SRL, compared to SDL. Self-regulation focuses more on the individual's role in learning after "what is to be learned" has been determined, e.g., monitoring their progress, determining when they are having problems, and adjusting their learning or behaviors accordingly. As such, self-regulation is associated with knowledge acquisition, skilled performance at the end of training, and self-efficacy (Ford, et al., 1998). These factors have also been linked with effective training outcomes (Colquitt, LePine, & Noe., 2000; Ford et al., 1998; Kozlowski et al., 2001).

SDL and SRL have broad implications for integrating mobile devices in AIT. Among the issues for consideration in allowing AIT students to use these devices will be:

1. Use of the devices for Army training and education purposes vs. other uses,

2. Whether use will be guided by the instructor or completely self-directed,
3. Whether the user will monitor and evaluate their use of the device and self-direction, and
4. Individual characteristics of the learner, including self-efficacy, experience with mobile, and self-directed learning, and readiness for self-direction.

Instructional designers and instructors themselves should consider these issues when identifying optimal opportunities, objectives, and contexts for mobile device integration. Prior assessments of student capabilities, motivation to use devices, tendencies toward self directed learning, and the specific applications of the devices themselves should also be considered. For example, in situations where students may not be assessed as highly self-motivated or self-directed, perhaps networked applications of the devices may better support learning objectives by providing additional feedback and oversight of their progress than more independent learning tasks or activities. Alternatively, where students appear highly self-motivated, more individual tasks or exercises implemented on mobile devices providing greater opportunities for autonomous self-directed learning may prove more effective.

Goal setting. Common to both SDL and SRL theories is the concept of goal setting. Goal setting (Locke & Latham; 2002) is actually a motivational theory, but can be considered an important practice related to assisting adult learners to specify, manage, and support their self-development. The acronym SMART (specific, measurable, achievable, realistic, and time based) has been used to represent the most important elements of successful goal setting. Mobile technology could play a role in several ways to support goal setting and self-directed learning, including providing access to information to establish goals and rewards, serving as the tool for managing and tracking goals, and providing access to information necessary to achieve goals.

Problem-Based and Studio-Based Learning. Problem-Based Learning (PBL) and Studio-Based Learning (SBL) are two similar techniques of scenario-based learning that have received considerable attention in the research literature. PBL was primarily developed in the mid-1960s as a useful instructional alternative to conventional teaching. PBL is an instructional model originally developed in medical schools, in which students are given a complex problem to solve that may not have a single correct answer (Hmelo-Silver, 2004). The teacher acts as a facilitator and guides the learning process through open-ended questioning, thus promoting self-directed learning and facilitating a sense of intrinsic motivation. Hoffman and Ritchie (1997) proposed that the learners in the classroom become researchers and work in small groups to analyze problems, determine solutions, and evaluate problems when utilizing PBL. Successful examples of using PBL in computer science include the teaching of object-oriented programming in the context of game design (Ryoo, Fonseca, & Janzen, 2008), learning computer programming logic via PBL (Pereira, Zebende, & Moret, 2010), and in Army leader development using the case method (Zyblut, Brunner, & Vowels, 2007).

Studio-Based Learning (SBL) has its origins in design fields, such as architecture and art. Lackney (1999) provided an overview of SBL history, tracing its roots back to the late 1800s. SBL centers on students constructing their own solutions to assigned problems, and receiving critical review and participating in discussion with instructors and others. Hundhausen, Agrawal, Fairbrother, and Trevisan (2010) identified the following four key steps related to SBL processes.

1. Students are given meaningful problems for which there are multiple solutions and for which they have to construct solutions individually or in groups,
2. Students present their solutions and justifications to the entire class,
3. Their peers critique the solutions and provide comments, and
4. Students are given the opportunity to respond to comments and criticisms, and modify their solutions appropriately.

However, in the same article, the authors found no differences in learning outcomes between an experimental group receiving SBL and a group receiving more traditional instruction. They did find that the SBL group reported increased self-efficacy and greater learning from peers, measured through self reports. Reardon and Tangney (2011) in a recent case study using college freshmen as part of a computer programming course found SBL provided support for the motivation and programming achievement of the students, though no experimental comparison was made.

Certainly both PBL and SBL strategies can be found in AIT and therefore, the findings relevant to successful applications of mobile devices using these methods have direct implications for AIT. Perhaps more relevant to medical, law, and other "case" based tasks, these methods may still have relevance for student collaboration and communities of practice within MOSs or occupational fields. In those tasks and MOSs where cases or problems serve as the primary stimuli for application of learning, the use of devices to implement PBL and SBL practices are more likely to be effective and prevalent. However, it is likely that nearly all MOSs have some potential for case- and problem-based learning applications.

Instructional scaffolding. Originating from cognitive learning theory, scaffolding in the context of instruction refers to instructors, peers, or others providing support and structure for learning. Scaffolding is often used in order to support problem-based learning (PBL). Scaffolding may occur in formal learning settings or on the job, through apprenticeship (Nielsen, 2008), mentoring, and job shadowing, among other means. The practice of scaffolding is related to Vygotsky's 'Zone of Proximal Development' which described the developmental gap that exists between independent problem solving and that which could be achieved through expert guided instruction (Vygotsky, 1978).

Salmon (2000) developed a five stage model of interactivity and learning in online learning used by Lim and Siraj (2011) as a means to promote scaffolding of mobile learning, consisting of

1. Access and motivation –involves welcoming and encouraging as well as providing technical support during the set up, access, and support of the use of technology,
2. Network socialization –involves familiarizing and providing bridges between cultural, social, and learning environments during the sending and receiving of messages,
3. Information exchange –involves facilitating tasks, discussion and supporting the use of learning materials during searching, and other social applications of the devices,
4. Context and knowledge construction –involves facilitating the learning process and open activities during conferencing, and
5. Development – involves supporting and responding when needed.

This model represents a potentially valuable structure for developing scaffolding activities in mobile devices, though it has not been researched extensively. Scaffolding, in general, is likely a critical topic for examining how mobile devices would be applied in AIT to ensure instructors are monitoring, supporting, and evaluating Soldier learning and aware of the potential for information that might lead to "negative" training. Mobile devices offer a capability to extend the reach of the instructor beyond the classroom and range setting, as well as the scheduled limits of training time. Scaffolding practices also offer a means through which to better communicate the value of implementing mobile devices as a means to assist, rather than replace, the instructor. This may be important as reluctance based on these probable instructor concerns could prove to be a major barrier to integrating mobile devices in AIT.

Experiential learning. Experiential learning was defined by Kolb (1984) as "the process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping and transforming experience" (p. 41). In this sense, experiential learning can be seen as an extension of constructivism. Kolb's Experiential Learning Theory proposed that cycles of action, feedback, reflection, adaption, and abstraction allow students to learn by doing and reflecting upon their experiences. The distinction between experiential learning and more traditional forms of learning using instructor guidance is that experiential learning begins with action or practicing what is to be learned instead of instruction or guidance. A corresponding Learning Styles Inventory was developed to assess orientation toward experiential learning (Kolb, 1976). However, the effects of learning style on learning transfer have come under considerable criticism with little empirical evidence supporting learning style effects on learning outcomes (Bergsteiner, Avery, & Neumann, 2010).

Experiential learning, in the context of training, would be most related to the concept of practice, feedback, and input from others to improve performance. These elements are integral to AIT. However, expanding experiences to mobile devices requires careful attention to the fidelity of the mobile device and learning experience to ensure appropriate video and audio stimuli, equipment responses, and feedback are provided. There are limits to the capability of mobile devices to provide high fidelity training, particularly in highly technical and tactile environments. As simulation capabilities continue to emerge through mobile devices and peripherals become more prevalent, the experiential aspect of mobile device use will improve, but there will likely always be significant limitations to mobile device capabilities compared with real equipment and range conditions. Partially offsetting these limitations is the central advantage of mobile devices to allow more students in different environments to experience training, in whatever form (e.g., lecture, observation, gaming, etc.), in a more timely, cost effective manner. So, while the experience may not be as robust, the ability to share the experience and deliver it in any number of physical environments is greatly increased.

Situated and authentic learning. Following from the constructivist theory of learning, and also closely related to experiential learning, are situated and authentic learning practices that are based upon the notion that learning occurs and is influenced by the culture, context, and activities in which the performance takes place (Lave, 1988). Lave and Wenger (1991) described learning as not merely the acquisition of knowledge but instead a process of social participation. Situated learning then requires that "knowledge be presented in authentic contexts

(settings and application that would normally involve that knowledge) and learners to participate within a community of practice" (Naismith et al. 2004, p. 13).

Unfortunately, there is not much empirical literature related to the effectiveness of situated and authentic learning. However, the literature of simulation fidelity (e.g, Allen, Hays, & Buffardi, 1986; Issenberg, McGaghie, Petrusa, Gordon, & Scalese, 2005) could be extended to provide support for the notion that the greater the similarity between the training context and the performance environment, the greater the transfer of that training.

As applied to technical training, the implications of situated and authentic learning support prevailing institutional and unit training strategies, particularly training using actual equipment under field conditions. In terms of their applicability to AIT, the use of ranges, actual equipment, and conditions which simulate or replicate real world conditions would be viewed as more effective than classroom, instructor led, or even remote environments that cannot fully replicate on-the-job conditions. Many of the issues identified with experiential learning with respect to mobile devices are relevant to situational and authentic learning practices.

Collaborative and cooperative learning. Collaborative and cooperative learning (the terms are used interchangeably) involve interactions between learners to improve the learning experience. Cooperative learning has been defined as working together with another person or group to accomplish shared goals (Lefrancois, 1999, p. 539). Johnson and Johnson (1994) described three types of learning: individual, competitive, and cooperative.

A number of research efforts have demonstrated that cooperative learning increases learner's motivation when compared with traditional, instructor led approaches (Johnson & Johnson, 1989; Slavin, 1995; Sharan & Shaulov, 1990). In addition, collaborative activities have been found to significantly improve the effectiveness of a learning experience, increasing both individual and group performance (Webb & Palincsar, 1996). Looi, Chen, and Ng (2010) found that use of a collaborative software technology resulted in higher assessment scores, more opportunities to participate in class discussion, and exposure to diversified ideas for students in primary school science classes. Austin, Smyth, Rickard, Quirk-Bolt, and Metcalfe (2010) provided an overview of the empirical findings in support of the value of collaborative learning including deeper understanding and knowledge of others (Bonk & King, 1998; Kasper, 2000), increased focus on problem solving skills as a result of engaging with others (Damon, 1984; Johnson & Johnson, 1988), and long-term retention of learned material (Garrison, Anderson, & Archer, 2001; Johnson & Johnson, 1999).

Mobile devices offer significant promise related to improving the methods, availability, and outcomes associated with collaborative and cooperative learning. Mobile devices have already demonstrated their ability to facilitate social networking for collaboration and that can be taken advantage of in various training settings.

Computer-assisted and computer based learning and instruction. For decades, the personal computer has dominated our work, information processing and access, and learning domains. The use of the computer to improve human performance and learning occurs primarily through the ability of various devices to provide:

1. Information access and networking,
2. Self directed and self-controlled sequencing (linking),
3. Visual and auditory stimulation and simulation,
4. Simulated tool control and interactivity, and
5. Performance enhancement, feedback, and support applications.

For MOSs that rely on information and processing, the computer is indispensable and users must understand their computer's capabilities and functions to carry out their responsibilities. Learning with computers is an expected and required part of their training and daily routine.

For those tasks that require psychomotor skills, computer based learning has increased access to and practice with the functional tools while reducing costs, providing safe practice environments, and giving timely feedback that is often not possible under operational conditions. The contribution of handheld devices to psychomotor skill development has been demonstrated with various recent generation gaming systems. Fundamental movements related to a wide variety of sports such as golf, bowling, table tennis, etc. are encouraging users to mimic the actual motions used during these sports. Marksmanship trainers using computer driven video screens, modified weapons, and weapon effects can streamline their skill development in barracks, aboard ships, and other locations. However, it should be noted that these fundamental movements may actually encourage negative behaviors, and therefore it is critical to determine the tool-system interface fidelity and integrated assessments when assessing the value of such a system in transfer of skills.

The capabilities of mobile computing devices to extend the effects of computer-based and assisted instruction are emerging but largely unexplored. Many social, game, and other applications contribute to navigation and enjoyment, but learning-specific applications are primarily focused on traditional delivery formats (e.g., books, photos, videos) and testing practices. This review has identified a variety of learning theories and practices related to determining how, when, where, and perhaps most importantly why, these devices can improve existing training practices to address real world performance issues. The following section addresses representative lessons learned organized by device characteristics, rather than learning theory constructs.

Mobile Training Device Lessons Learned

The learning theories reviewed previously are generally applicable to most training contexts, including AIT. There is another line of research that is applicable to using mobile devices in AIT. While the learning theories clearly focus on instructional methods, the other line of research focuses on the mobile learning device itself. This line of literature is mostly theoretical; however, recent research studies have implemented mobile device learning and provided some informative observations. These observations serve as lessons learned for implementing mobile learning. Most of the literature discussed in this section considers non-military training contexts and recommendations from mobile learning theorists from academia. Insights regarding military training contexts were gained from discussions with key personnel

overseeing the Army's Connecting Soldiers to Digital Applications (CSDA), pilot tests, which explored the usability and utility of mobile devices specifically in an Army training context.

The literature on lessons learned regarding mobile learning can be sorted into two domains: usability and utility. Usability topics include basic device functionality in the training context and learner training requirements. Utility concerns the usefulness of mobile training devices for training. In this section, utility is discussed for both learners and instructors. Also mobile training effectiveness literature is reviewed to identify the training outcomes that are affected by mobile devices.

Usability. Usability literature directly addresses many important ease-of-use issues related to implementing mobile learning. Low and O'Connell (2006) suggested that as usability was a catch word concerning the design of computer interfaces, it should also be considered along with the concept of user-centric learning in developing mobile resources. Usability issues need to be evaluated within the training context for each block of instruction in order to determine if a mobile learning approach should be implemented. Mobile learning is meant to facilitate the learning process (Jeng, 2010). Usability does, of course, have bearing on the devices' utility: if the usability is so poor that it hinders learning, then there is limited utility. If the use of technology does not add value to the learning process, then it is unwarranted. To aid in the evaluation of usability the following topics are discussed: usage guidelines, security, device requirements, cost, and mobile device limitations.

Usage guidelines. Usage guidelines are required to identify when users will be allowed to possess mobile devices and what user permissions they will have. Usage guidelines suggest how mobile learning devices will be used formally and informally by learners in AIT. This section considers guidelines to prevent misuse and provide information security.

The Army Learning Model (2011) identified the capability of mobile learning devices to be a disruptive technology. The disruptive uses and potential for distraction need to be considered in creating instructional guidelines and policy. The CSDA pilot testing provided examples of how phones can become distractors without effective guidelines and policies concerning usage. In the formal instructional environment, some Soldiers' attention was diverted from instructors (e.g., personal e-mail, playing games). These distractions take away from the current effectiveness of the AIT training context.

CSDA pilot testing noted that distraction problems were most likely to occur in Soldiers who are inexperienced and still coming to understand Army behavior and acceptable Army equipment use. Distractions can be minimized by explaining the proper use of the phone during training and clarifying user restrictions.

The challenge to establishing guidelines for effective use is that innovative and creative uses for mobile devices should not be stifled. Sharples (2009) discussed the unpredictable nature of mobile device usage and identified three types of unpredictability related to mobile devices. First, the context of mobile device use is unpredictable. Context of use refers to the specific circumstances that explain the environment and how users will be prompted to use mobile devices (e.g., for an assignment, or informally based on their interests). This unpredictability can

remove the distinction between formal and informal learning environments and introduce uncertainty as to how mobile devices will be used. Second, the learning process is unpredictable. The learning process refers to the types of activities that the learner will engage in (e.g., reading, watching, collaborative exercises). Learners can be guided through training by instructors, but the individual Soldier's learning process and use of mobile devices in training will differ. Lastly, the mode of use is unpredictable. The mode of use refers to how learners use mobile device capabilities (e.g., the Internet, camera, etc.). The full extent of how technology and its capabilities can be leveraged and exploited is unknown until it is placed in the hands of users. These examples of unpredictability depict the challenges associated with creating adequate guidelines while not deterring innovation and creative application.

Security. The Army Learning Model (2011) identified the need to quickly resolve and implement security safeguards concerning mobile devices to exploit the usefulness of mobile devices for learning. Security safeguards must address usage restrictions. Mobile learning devices link learners to the outside world (Naismith et al., 2004). While this may become a distraction in formal training contexts, it can be a benefit in informal learning. However, informal training contexts, such as the barracks, are less easily monitored and thereby more susceptible to misuse. Naismith et al. noted the importance of providing security and privacy for learners.

Given the communication restrictions that are placed on Soldiers during AIT, training designers must decide what level of mobile device functionality and connectivity is appropriate for Soldiers. TRADOC 350-6 Training: Enlisted Initial Entry Training (IET) Policies and Administration states that cell phones, pagers, and electronic devices are subject to control during Phase IV and V of AIT. During these phases, "Privileges are earned, and are granted, reduced or modified at the commander's discretion based on Soldier performance and discipline (TRADOC 350-6, p. 20)." Such privileges often include use of a cell phone or computer. In the CSDA pilot testing, some Soldiers in AIT were disciplined for removing the memory card and changing user restrictions. Security policies and usage restrictions should be accounted for in mobile training device programming and application design and Soldiers should be made aware of policies, restrictions, and consequences for tampering with a mobile device's user restrictions or security systems.

Training needs. Despite some Soldiers' personal experience with mobile devices, most Soldiers still require training (at least on their use as Army equipment and functionality), as they would with any new type of equipment; Army Learning Model 2011). CSDA pilot tests found that after Soldiers were trained on the devices, they said that they were more capable of using the phones. These findings suggest that Soldiers can benefit from training on how to use their mobile devices.

Soldier's technological capacity and previous experience with mobile devices can be misleading. Each Soldier's experiences will vary. This combined with the unpredictability of how Soldiers will use the devices suggests Soldiers should be trained in the functions of the device as well as how to use the specific applications that will be used in training. This type of training will ensure the integration of mobile devices into the learning process. Additionally,

training should be provided to identify Army guidelines and policies concerning mobile devices, as would be customary for any other equipment.

Similar to Soldiers, instructor's level of mobile device experience will vary. Instructor experience level can impact how instructors are expected to use devices in teaching. Instructors need to have a mastery of mobile device instruction. Just as instructors would be seen as an expert on any other piece of equipment that they use to train, so too will they need to have command of mobile devices. An important difference between mobile devices and other Army equipment is that, in some instances, students could have more experience with mobile devices than instructors. Instructors may require training on mobile device functions and the utility of devices for their courses.

Mobile device functions. Research has identified several variables to consider for choosing a mobile device. Device functions have improved and new hardware has led to new instructional and software application capabilities. Research, including the CSDA pilot tests has also examined user preferences regarding device functions and capabilities. A mobile learning device's instructional and software application capabilities are dependent upon device functionality (e.g., hardware and the supporting infrastructure). In some instances shortcomings related to device hardware and infrastructure can be overcome through effective instructional design. Low and O'Connell (2006) suggested that individuals responsible for designing and implementing mobile learning need to become educated and aware of the multiple platforms and formats available to understand the quality and requirements that are most suited for their usage.

Device functions need to be taken into consideration prior to selecting a device, and once a device is selected a comprehensive list of capabilities needs to be identified. A list of capabilities should guide design. Desired capabilities could be used to identify how technology could be leveraged to achieve learning objectives and improve instructional techniques. Learner activities and other instructional capabilities are dependent upon mobile device functions. Jeng (2010) and Klopfer, Squire, and Jenkins (2002) described two methods for identifying device capabilities and providing objectives or examples as to how the device capabilities can be used. Jeng identified capabilities related to basic functions of mobile devices (e.g., video recording) and Klopfer et al. identified capabilities related to how the user can use mobile devices (e.g., portability).

Some of the basic functions available on mobile devices are network connectivity, picture taking, video recording, a global positioning system (GPS) receiver, and radio frequency identification (RFID) readers (Jeng, 2010). Each of these functions could be leveraged during training. More functions on a device means more capabilities for training designers, instructors, and learners. A mobile device should be selected based on its functional capabilities. Following the selection of a device, functions should be listed in detail and compared to instructional practices to benefit training designers.

Klopfer et al. (2002) created a taxonomy for understanding the capabilities of mobile devices. The factors in the taxonomy are portability, social interactivity, context sensitivity, connectivity, and individual differences (e.g., age, familiarity with mobile devices, etc.). Similarly, Tucker (2010) identified several capabilities that are common to mobile devices:

connectability, portability/wearability, instant accessibility, flexibility, economic viability, social interactivity, context sensitivity, and individuality. The literature on learning theories and instructional techniques is most relevant to the social interactivity, context sensitivity, and individual differences factors. Those factors are very interrelated to the training context and instructional strategies. This section concerns the factors that are most specifically related to using mobile devices, portability, durability, and connectivity.

Portability. Portability refers to the device size and ability for devices to be easily carried by users. The CSDA pilot tests identified portability and screen size as limitations. These variables often opposed one another (e.g., as screen size increases portability decreases). Similarly, the recommendations were presented as trade-offs. Soldiers wanted a small device to ensure portability, but noted that device features and application usage is degraded if the device is too small. Similarly, Suki and Suki (2011) found that learners objected to the screen size, specifically because the training they received prior to the learning device was delivered on a larger, more user friendly, screen.

Low and O'Connell (2006) suggested two guidelines that could help address the issue of screen size. First, choose fonts and graphics that are easy to view and second, carefully create pages to prevent scrolling in two dimensions. Additionally, designers should eliminate unnecessary code, content, and operations; use space efficient formats and appealing color palettes for creating media; and divide content into small objects so users can download what they need. These guidelines are an example of design features that can be used to address limitations of screen size.

Durability. Durability refers to the ability of a device to be used and not get damaged in harsh environments. Durability is related to a device's portability as fragile devices become more susceptible to damage and therefore less useful. Soldiers suggested that a lack of durability in a mobile learning device is an impediment to its use. This limitation can lead to infrequent use in field environments, especially when field training is unpredictable (e.g., inclement weather, physically rigorous training conditions). It is possible to increase the durability of devices by adding additional carrying cases to the devices. However, this equipment is an additional cost and does not completely eliminate durability issues.

Connectivity. Mobile device connectivity capabilities include networking mobile devices, connecting users to a central network, and linking users to the internet (Klopfer et al., 2002; Naismith et al., 2004). Connectivity capabilities expand training options and meet the desires of trainees. More access to the internet and improved internet connectivity was the most frequent response from Soldiers concerning additional/desired features for mobile devices. Soldiers wanted access to e-mail, AKO, Army Times, and social networking. Connectivity capabilities require security considerations and usage guidelines. Once usage policies have been established, connectivity can be leveraged as a resource to meeting learning objectives and enhancing instructional techniques.

Utility. Utility concerns the effectiveness of using mobile devices for training. This section will discuss research findings that describe how mobile devices are useful to learners and

instructors. Further, the utility of mobile learning is reviewed by examining the effect of mobile learning on training outcomes.

Learners. Low and O'Connell (2006) created a taxonomy to identify mobile learning activity from a learner-centric perspective. Using a mobile device, a learner can record, reinterpret, recall, and relate. Low and O'Connell suggested the recording activity is based on a constructivist type of learning. Learners gather and build information during training. In CSDA pilot tests, Soldiers identified the ability to take pictures and video as advantages to mobile learning in Army training. In this effort, mobile devices were effective in tactical training contexts for gathering, sharing, and storing information.

The reinterpret type of mobile learning activity consists of the learner analyzing and transforming existing knowledge and resources (Low and O'Connell, 2006). The reinterpretation of data and resources provides the user an additional tool for learning to capture and evaluate what is learned in formal training. For example, a Soldier could select relevant information from courses, training materials, and other materials to enter into a training journal, to create a timeline of their learning, or help them remember the most important things they learned. Reinterpretation relies on the processing abilities of the mobile device to store information and the learner's ability to analyze existing sources of information.

The recall activity consists of learners using the mobile device to review existing information and resources (Low & O'Connell, 2006). Low and O'Connell suggested that recall activity is based on connectivist theories if training is learner-centric. Learners recall information as they explore their environment and make connections between what they know and information from resources to expand their network of knowledge. Instructivist theories are applicable to training with mobile devices if recall is teacher-centered. Instructors would guide and facilitate the acquisition of knowledge by identifying resources for recall. Soldiers in AIT could access existing resources as they see fit or benefit from existing resources with instruction and facilitation from an instructor. In CSDA pilot tests, Soldiers in AIT most frequently used mobile devices during training to prepare for classes and exams and refresh learning. Further, when Soldiers were asked to identify the advantages to using mobile devices, access to information and studying were among the top responses. Soldiers identified videos and interactive applications as the most desired mobile learning methods of instruction. Refresher videos and applications can reinforce material learned during formal training.

The relate activity considers the ability for mobile devices to link learners to one another to create a social context and network of knowledge (Low & O'Connell, 2006). Learners can network and learn with (and from) peers. Collaborative learning theories can be used to maximize the quality of interactions among peers. For example, a collaborative approach to learning could link Soldiers together, opening each individual as a resource to others. A linkage among learners would allow for cooperation and collaboration in group assignments. In CSDA pilot tests, Soldiers who had connectivity were able to share video and photographs to support their mission. Lastly, relate includes networks created between learners and instructors. Instructors could use mobile devices to reach beyond the classroom and provide additional support to students.

Instructors. Results from CSDA pilot tests suggested that instructors disliked mobile devices, in some cases because the content on the mobile devices did not parallel what they had been teaching throughout the rest of the course. This is contrary to Army guidelines for an integrated training environment (Army Training Concept, 2011). Holden and Westfall (2010) identified the ability to update content rapidly as an important aspect of a mobile device. The subject matter that is being trained must be examined to identify how likely it will be to change. Instructors and designers need to identify aspects of their courses that will require considerable content updates. If content changes too frequently then it would require frequent updating making it less suitable for mobile devices due to the increased cost of updates. Instructors could be given the ability to make changes directly to content, but they would need to be provided training and technical support to ensure that they are able to improve and adapt their course content (Naismith, Lonsdale, Vavoula, & Sharples, 2004).

The integration of mobile devices into AIT is dependent upon the instructor's level of involvement. To ensure seamless integration, instructors should be consulted in the development of training applications. Including instructors in the design process improves the quality of training, ensuring that content is accurate. Further, instructor involvement in design encourages instructors to buy into the inclusion of mobile devices in training.

Criteria for evaluating mobile learning outcomes. There is a lack of experimental evidence regarding the effectiveness of mobile devices for learning (Tucker, 2010). In the absence of studies that explore a causal relationship between mobile learning and the effectiveness of training outcomes, there has been survey and interview research conducted using learner and instructor samples that examines perceptions of effectiveness. This research suggested that learners' performance can improve using mobile devices and that other indirect performance factors such as motivation and communication were also improved.

The data collected from surveys of Soldiers who participated in CSDA pilot tests suggested that Soldiers believe there are many positive benefits from using mobile devices. Soldiers identified several impacts directly related to learning, such as understanding the course, retention of what they learned, and awareness of lesson content. Additionally, Soldiers said that mobile devices increased time spent studying, increased motivation to learn, and improved interactions with classmates and instructors (e.g., easier communications via text). Regarding performance improvements, mobile devices were perceived to be more beneficial to Soldiers as the pace of their training mission decreased. It was not possible to collect objective data on their direct performance impact during this research effort.

Mobile learning has been shown to increase learners' motivation. Students reported that mobile learning improved their interactions and increased their motivation to learn (Motiwalla, 2007; Zurita & Nussbaum, 2007). Students' perceptions of their increased motivation to learn suggest that mobile devices can be a tool to improve learning. Motivational theories in mobile learning literature identified several reasons why motivation is improved: control over goals, ownership of learning, learning with mobile devices is more fun, improved communication, and learning in context and continuity between contexts (Jones, Issroff, & Scanlon, 2007; Sharples, 2009). Notably, these reasons overlap with learning theories and instructional techniques, (e.g., self-directed learning, goal setting).

Summary

Factors that require consideration when implementing mobile devices into AIT. Our review of the published literature has identified various factors that need to be taken into consideration when implementing mobile devices into AIT. By proactively considering these various issues decision makers will be more effective at designing and implementing training using mobile devices. Based upon the literature, our synthesis of the existing theory and practice related to the use of mobile devices in training identified the following factors: training context, user, and device. These factors and their respective considerations, recommendations, and guidelines are presented below. Future data collections will add to and elaborate on this list of factors, considerations, and recommendations.

Training context considerations.

1. Content/Training objectives – The focus of determining the value of supplementing, replacing, expanding, and integrating AIT content using mobile devices should start with an examination of the objectives of the training. Content issues include the following items:

    a. Basic knowledge, skills, and behaviors individuals need to become Soldiers (FM 7-0). Skill acquisition and technical training is especially important in AIT due to focus on MOS-specific training.
    b. Training requirements on specific equipment and systems.
    c. Format of content – text, audio, video, interactive media, etc.
    d. Proficiency standards and criteria for evaluating MOS specific training: mobile devices can improve performance and indirect performance factors such as motivation and communication.
    e. Knowledge, Skill, and Psychomotor aspects of each MOS.
    f. The consistency of course content.

2. Learning environment – The learning environment, which has expanded beyond the classroom and field to include online, mobile, and application driven modes, must be evaluated for fidelity, cost, and transfer aspects. Learning environment issues include the following items.

    a. The mix of instructor led, self directed, and mobile training,
    b. The amount of collaboration within the environment,
    c. The nature of the learning opportunities and the focus on knowledge, skill acquisition, practice, and feedback.

User considerations.

3. Instructional Theories - Instructional theories can be leveraged in the design of mobile training. The instructional theories include the following items.

a. Behaviorism and Operant Conditioning - How can mobile devices be used to correctly portray the conditions, stimulate responses, and provide feedback to the learner?
b. Cognitivism - How can mobile devices be used to reduce the mental load on students and assist in organizing the knowledge and skills to be learned?
c. Constructivism - How can mobile devices be used to allow the learner to discover their own "truth?"
d. Andragogy - How could learners use mobile devices to allow them autonomy and the ability to direct their own learning activities?

4. Instructional practices can be leveraged using mobile devices. Training designers and instructors can use practices in the design and implementation of training using mobile devices. The applicability of instructional practices should be considered. The instructional practices include the following items.

    a. Self Directed Learning (SDL) and Self Regulated Learning (SRL) – SDL and SRL can be leveraged using mobile learning devices by allowing learners to take initiative in their learning, with control over their training and learning on individually controlled mobile devices. Further mobile devices can be used to monitor learning progress.
    b. Goal Setting – Mobile devices can be used to support goal setting and serve as a tool for managing and tracking goals. Also, mobile devices can be used to identify resources and information to achieve goals.
    c. Problem Based and Studio Based Learning – Instructors facilitate the learning process using mobile devices through open-ended questioning that encourages learners to identify solutions using mobile device references and peer collaboration. Game-based apps can also utilize problem-based learning approach for training.
    d. Instructional Scaffolding – Mobile devices allow instructors and peers to provide support and structure for learning.
    e. Experiential Learning – Training using mobile devices should incorporate practice, feedback, and input from others to improve performance.
    f. Collaborative and Cooperative Learning – Mobile devices facilitate communication and social networking allowing students to interact in a number of different ways with a large community of individuals and groups.
    g. Situated and Authentic Learning – Mobile devices should be used in authentic environments (e.g. the use of ranges, actual equipment, and conditions). Real field or office settings should be training contexts considered for the development of mobile training. For instance, mobile device applications could be used during range training when there is a limited availability of training resources for learners to get hands on training.

5. Instructor – The instructor serves as the mechanism for controlling student exposure, experience, and feedback during training. Instructor issues include the following items.

    a. Background and qualifications,

b. Knowledge of mobile device capabilities,
c. Ability to construct training support system, and
d. Instructors can be resistant to the use of mobile devices. They should be included in the design of training to get buy-in and ensure that mobile applications are consistent with their curriculum. Instructors should also be informed about mobile device capabilities that could enhance the instructor's effectiveness. For example, mobile devices could be used for scoring and item analyses of embedded knowledge checks or quizzes that are administered via the device.

6. Student – The student represents the target of training transfer and the performance mechanism. Student issues include the following items.

    a. Background and experience,
    b. Self efficacy,
    c. Readiness for self directed learning, and
    d. Various other personal characteristics related to motivation, group orientation, and learning orientation.

Device considerations.

7. Device capabilities – Device capabilities describe the specific functions and capabilities of mobile and digital devices. Further, capabilities require linkage to training objectives. Device capability issues include the following items.

    a. Mobile device selection and design - A mobile learning device's capabilities are dependent upon device hardware and the supporting infrastructure. Desired device functions and usage capabilities need to be taken into consideration prior to selecting a device, and once a device is selected a comprehensive list of functions and capabilities needs to be identified.
    b. Basic device functions - Basic functions available on mobile devices need to be identified once a device is chosen (e.g., network connectivity, picture taking, video recording, a global positioning system (GPS) receiver, and radio frequency identification (RFID) readers). More functions on a device mean more capabilities for training designers, instructors, and learners.
    c. Device functions should be used to generate usage capabilities and then capabilities can be compared to learning theories and instructional practices to benefit training designers. This comparison exploits device functions to meet learning objectives.

8. Device Usability and Utility – Device usability and utility should be considered when developing training. Usability considers basic device requirements for implementing mobile learning in AIT. Utility considers how basic device features can be used by learners.

    a. Usage guidelines - Usage guidelines should not restrict creativity or innovation. Guidelines should consider use in formal and informal training contexts. Usage

guidelines should ensure that devices are not tampered with or misused. Usage guidelines should adhere to communication restrictions and standards in AIT.

b. Security – Security policies and usage restrictions should be considered in the selection of a device and in applications created for a device.
c. Training Needs - Soldiers should be made aware of policies, restrictions, and consequences for tampering with a mobile device's user restrictions or security systems. The disruptive capabilities of mobile devices can be minimized by explaining the proper use of the phone during training. Additionally, Soldiers should be trained in the functions of the device as well as how to use applications that will be used in training.
d. Design recommendations that effect usability include the following items.
    i. Choose fonts and graphics that are easy to view.
    ii. Carefully create pages to prevent scrolling in two dimensions.
    iii. Eliminate unnecessary code, content, and operations.
    iv. Use space efficient formats and color palettes for creating media.
    v. Divide content into small objects so users can download what they need.
e. Utility capabilities – A device's utility capabilities rely on training designers' ability to consider and exploit basic device functions. Utility capabilities need to be considered in the development of training to fully utilize device functions. These capabilities should be leveraged for a purpose (e.g., live events, online content, collaboration, assessment, reference materials)
f. Portability – Screen size limitations and portability need to be considered in the design of training and the selection of a training context. Functional screen size contributes greatly to how portable the device is: mobile device usage can be negatively affected if devices are not portable and if materials are not easily viewed.
g. Durability – Mobile devices need to be durable to be effective in harsh environments. Devices that break easily should require a protective case. Training contexts where devices are extremely susceptible to damage should be minimized.
h. Connectivity - A device's network functionality determines user capabilities for accessing information. Mobile device connectivity capabilities include networking mobile devices, connecting users to a central network, and linking users to the internet. Designers and instructors should leverage connectivity to better link learners to training resources. Connectivity should be used to encourage collaboration and cooperation among peers and with instructors. When connectivity is not feasible, designers should consider a native app that still provides quality individual training without requiring access to a network or connections with other users.

These factors were used as the basis for developing data collection instruments, as described below.

Method

The purpose of the data collection was to identify the factors and considerations that are most important to designing and implementing mobile learning technologies in AIT. The objective of the data collection was to allow the research team to further refine the initial list of key factors and considerations identified in the literature review. The final product of this research was a practical decision guide that addressed the most important factors and provided recommendations and guidance that could be used to help design and implement digital applications and handheld mobile devices in Army training settings.

Instruments

The instruments used during this data collection were created from a framework of considerations summarized at the end of the literature review (i.e. training context considerations, user considerations, device considerations). Copies of these instruments, a survey, and a focus group protocol with open ended questions, are provided in Appendix A.

The paper and pencil survey consisted of five sections. In the first section, participants were asked to provide basic background information, as well as, summarize their experience with mobile learning. The second section asked participants to describe their experience using the instructional practices identified in the literature review in conjunction with mobile devices. The third section asked participants to identify the potential impact of using mobile devices with various instructional practices to increase or enhance learning outcomes. The fourth section asked participants to rate the effectiveness of using mobile devices in various training contexts (e.g., classroom, field/range). In the fifth section, participants were asked to rate the importance of various considerations relating to training context, users, and devices. Results from the quantitative analysis are provided in Appendix B.

The focus group protocol also consisted of five sections. The first section consisted of questions designed to learn more about participants' experience using mobile devices in training. The second section focused on the training context. An example question from that section is, "What types of tasks or training objectives would be most appropriate for training with digital applications and mobile technologies?" The third section concerned user considerations. An example question from that section is, "What is the best way to ensure instructors buy into the use of digital applications and mobile technologies in their training?" The fourth section concerned device considerations. An example question from that section is, "Which is the most important device consideration when integrating digital application and mobile technologies into AIT training: usability, utility or capability?" The final section consisted of a wrap-up question to gather additional considerations, lessons learned, or guidance that participants had not yet offered.

Participants

In order to achieve a comprehensive sample, participants with unique perspectives and experiences with mobile learning were obtained. Table 1 displays participants' positions. The

survey and focus group questions were administered to a total of 54 participants from Fts. Bliss, Gordon, Leonard Wood, Sill, and Lee.

Table 1
Participant Position

Position	Sample Size
Training Developer	9
Student	14
Instructor	8
Commanders	2
Other	21
Total	54

The training developers were Army civilians and one uniformed Army leader with experience in developing digital applications and interactive media instruction for handheld devices for Army units. The students and instructors had experience using handheld mobile devices such as the iPhone and Samsung Galaxy Tablet during AIT or BOLC. The commanders had previous experience overseeing and implementing the integration of handheld mobile devices and mobile learning in AIT.

Of those participants that identified themselves as "Other", most provided more specific position titles. For example, rather than identifying themselves as a Training Developer they said that they were a Training Tech 1702 or an Instructional Systems Spec 1750. Others provided their specific position along with their organizational affiliation, e.g., Chief of mobile applications branch, Lead Developer of mobile applications branch, Deputy of technology for the mission command complex.

Other factors that contributed to a comprehensive sample were the mix of civilian and military participants, as well as, participants rank or GS level. Table 2 displays the breakdown of participants' military rank or GS level.

Table 2
Participant Rank or Level

Civilian		Enlisted		Officer	
Rank	Sample Size	Rank	Sample Size	Rank	Sample Size
GS9	3	PFC	3	2LT	9
GS11	7	PV2	2	CPT	4
GS12	3	SSG	3	MAJ	2
GS13	3	SFC	4	LTC	1
GS14	2				
Civ (unidentified GS Level)	4				
Contractor	3	Total NCO	12	Total Officer	16
Total Civilian	25	Total Military	28		

Method of Analysis

In order to analyze this information, it was essential to organize the data according to the key considerations or factors that were identified earlier as most important to designing and implementing mobile learning. Then, within each factor, participant responses, both quantitative and qualitative, could be analyzed to provide greater detail and insight that would make the final list of key considerations or factors comprehensive and robust.

***Qualitative analysis*.** The literature review was used to generate a list of factors that are integral to implementing training using mobile devices in AIT. There were seven that were initially identified. They are presented in Table 3 with their linkage to the original list of factors identified in the literature review.

Table 3
Link Between Factors Used to Analyze Data and Factors Identified in the Literature Review with Descriptions

Factor from Literature Review List	Factor Name in Data Analysis	Description
Training Context	Training Content	Concerns the development of applications, including lessons learned and recommendations on how to develop applications for handheld mobile devices (e.g., expected time investments, expected barriers, application development process recommendations, etc.).
Training Context	Training Context	Concerns the environment in which the user takes the training.
User	Students	Concerns issues related to students' use of handheld mobile devices or digital applications.

Table 3 *continued*

User	Instructors	Concerns the issues related to instructor attitudes, experiences, preferences, and roles in handheld mobile device training.
Device	Application	Concerns the application used in the training, its creation, its use, and the potential value gained by utilizing the application.
Device	Device	Concerns device-related issues to better ensure successful integration of devices and applications into AIT.
Device	Networking, Security, and Implementation Issues	Concerns networking, security, and implementation issues that are important to consider when devices will require network access and data use and transmission are involved.

***Creating a theme list for analysis*.** Subfactors were created for each of the factors using the literature review and subject matter expertise gained from the data collection. For example, the "device" factor contained subfactors such as, device capabilities, portability, and durability. These subfactors were created to focus more closely on specific issues and organize data within each factor because the factors were too broad, and the issues within each factor too complex, to consider without further organization. The resulting list of factors and subfactors was used as a theme list to examine transcripts of the interviews, focus groups, and notes from the data collection.

To ensure coding remained open to new factors and subfactors, comments that did not fit into the factors or subfactors were coded as 'Other.' For example, an analysis of the 'Other' comments suggested that a new factor, labeled "Institutional Support" was worthy of being considered as a separate factor.

***Preparing for analysis*.** Before coding of the transcripts began, coders engaged in a calibration task. The purpose of the calibration task was to increase consistency among coders in how they coded and applied the factors and subfactors to comments from the transcripts. During the calibration task, two coders coded the same three transcripts. Coding consisted of identifying blocks of content within the transcript, then associating a specific factor and subfactor code with that block of content. Next, the coders compared, contrasted, and reconciled differences, as well as discussed coding methods for all three transcripts. Following the calibration task, coders proceeded with the coding of all remaining transcripts.

Presentation of the results. 23 transcripts were coded. After coding, all of the coded comments were extracted from their transcript and organized by their associated factor. Participants' comments for all of the factors and their respective subfactors are reviewed in the following section. Only the subfactors that contained enough participant comments for a thorough understanding and sufficient description are summarized in the results. A subfactor was considered to have enough comments if there were approximately 10 or more comments and those comments provided a clear understanding of the subfactor. The comments were synthesized into findings that were used to create a narrative for each of the subfactors. The

narratives provide a summary of subfactor and include the highest quality comments to display similarities or agreement among participants and present an accurate description for each subfactor.

During analysis it became evident that two additional factors (i.e. value and cost) were interrelated to all or most of the factors and therefore should be considered as overarching or integrated factors. These overarching/integrated factors defined the objectives and constraints that served as a broader context for decisions in the other factors.

Quantitative analysis. All of the questions in the survey were relevant to the factors that were identified in the literature review and qualitative analysis (including the purpose and cost factors). Table 4 displays how many questions were relevant to each of the factors.

Table 4
Quantitative Question Coverage of Factors

Factor	Number of Questions
Device and Application Value	2
Device and Application Cost	0
Application	2
Training Content	5
Students	3
Device	4
Training Context	4
Networking, Security, and Implementation Issues	1
Instructor	1
Institutional Support	1

Frequency distributions of participants' responses were examined. The frequency responses for items are reported in the results. The frequency percentages do not necessarily add up to 100% because only the negative and positive ends of the scale are presented. Midpoint frequencies are not presented because they did not lead to meaningful findings.

Results

The quantitative and qualitative results are reviewed in this section according to their associated factor. These findings were used to refine the list of factors and subfactors that were used to generate the decision guide.

Mobile/Digital Application

This factor concerns the actual application used in training, its creation, its use, and the potential value gained by its employment. There were a total of 302 participant comments examined for this factor. Two questions in the survey directly related to the *Application* factor. Seven subfactors were identified that helped clarify the most important considerations for this

factor. Table 5 lists the subfactors and the number of participant responses for each subfactor. Each subfactor is discussed with supporting evidence from the survey and data extracted from interviews and focus groups.

Table 5
Application Subfactors Comments

Subfactor	Number of Participant Comments
Development	69
Implementation	13
Information representation	14
User Interaction	6
Usability	27
Utility-Value	25
Compatibility	35

Development. This subfactor concerns the development of applications, including lessons learned and recommendations on how to develop applications for handheld mobile devices (e.g., expected time investments, expected barriers, application development process recommendations, etc.). There were many comments related to application development. The comments regarding lessons learned tended to focus on very specific and often technical recommendations. Specific recommendations on how to develop applications for handheld mobile devices focused on the application development process, including discussions of what the process consists of and recommendations for how development of digital applications should be conducted.

Participant Guidance. Many participants provided guidance concerning the development of applications, including the following items.

- General questions that developers need to ask.
  - "Why?" or "What is the purpose of creating an application?"
  - What is the best way to deliver content?
  - What are technical constraints?

- Development Specifications
  - The software that is used to program Android is 8.6 eclipse for Manscen Rapid Development Suite (MRDS).
  - Unity computer program programs for Apple, Android and RIM (blackberry).
  - iOS is more amenable to larger apps (in terms of storage, data size, etc).
  - Licensing
    - The goal was to get the Army to purchase an enterprise and developer license (free) and distribution license ($99) a year.
    - For Google, you need a license (one time fee $25).
    - It took 14 months to get an enterprise license and an additional three months to get the developer license.

- Bad developmental formats
    - Applications that contain contractor proprietary code.
    - Applications without a source file.
    - Applications that require developers to frequently recreate code in order to move forward.

- User Interface
    - Keep it simple.
    - Putting slides into a phone isn't that helpful.
    - Don't complicate the screens.
    - Ergonomics: assume a two-hand grip/hold or all thumb movement .
    - Use pull down menus to complete the forms with greater accuracy; reduces processing time.
    - Don't have lots of levels (about 3 tops).
    - Technical issue with apps: You can't hover to get more info like with a mouse
    - Take a Wikipedia style approach to TMs, FMs, etc versus pdf and page turning style.
    - Consider screen size when developing, especially if requiring some interactivity between device and user.
    - Make graphics 2.5 times the maximum resolution allowed so that as device display gets better, you have built-in better graphics without rewriting the apps.
    - Use .pngs not .jpegs for pictures.

- Iconology
    - Buttons have to reflect what it does.
    - Make buttons easy and intuitive to understand.
    - Use familiar pictures.
    - Balance what buttons need to be on a screen at the same time.
    - Buttons need to be big enough for user to touch.
    - Use a high quality graphic for buttons.

- Developer training
    - Many people don't have a programming background yet still develop applications.
    - There needs to be a middle ground between 1750 training developers and programmers.
    - Developers are not the only ones who need training. Training Staff and cadre need new skills. They need to become familiar and comfortable with technologies.
    - The basic programmer can't necessarily do mobile apps. It takes more skills to program but has to be combined with the training objectives.
    - The average training developer has been in their career for 20 years. How do you keep them fresh? You have to take the ADDIE [Analysis, Design, Development, Implementation, and Evaluation] course. Professional development is not mandated.

- Developers with a computer science background are needed and they can teach others how to do it:
  - Javascript,
  - HTML and Dreamweaver, and
  - Visual Basic Script
- For Career field/MOS 53 a critical task is that they must be able to develop an app.
- In 1980s, used to have an MOS for code writing. Currently there are no MOSs for coding.
- MOS 53s are as close as they come.

Recommendations on how to develop applications for handheld mobile devices. Many participants provided examples of the development process as well as recommendations for how the development process should be conducted. Several participants described the early stages of the development process focusing on the interaction that must occur among various stakeholders in order to produce the best results. One participant stated, "We [training developers] need to see the school coming to us and saying these are the areas that we need for distributive learning and app development and we help to assist them to meet those goals." Another participant described a lack of interaction among developers and subject matter experts: "School reps come to developers and say, we have great ideas for how to use mobile apps in our training, but then hand over a manual and ask for it to be put into an app."

Participants provided a high level overview of the development process as provided below.

- Interaction with customers.
  - Levels of interaction varies, and
  - Working on pipeline to deal with customers.
- Turning pub into ePub: Discourage or redirect to other lower-level programmers.
- Identify the wish list: Then prioritize the wish list.
- Then designer sits down and designs look.
  - Design document to see [storyboard] how it will look visually,
  - Get story board approval, and
  - 2 weeks to 3 months for this process.
- Time to develop ≈ one month.
  - Beta version,
  - Sponsor tests, and
  - Get feedback from sponsor [if there is a sponsor] before making correction (suggested by a user or by schoolhouse).
- Release beta to market.
- Minor push updates.

Early on, it is important to determine the level of effort required and whether or not available government training developers are capable of creating the desired application. A training developer thoroughly distinguished between the types of applications that are usually within the abilities of government training developers and those applications that require contractors: "Skill sets for application development, they're not hard if you do a couple of

buttons for Android. It is not hard to learn. The more complicated you get the harder it gets. IMI level 1 high school education. Level 2 is push a button/High school. Level 3 you need a BS to develop an app or several years equivalent and programming. I wouldn't put someone in my shoes off the bat. I have 10 years of practice. Mine was OJT [on the job training]. If I have that with the expectation to know coding in 3 years great. You don't have to have degrees. You have to have programming experience. Level 4 forget it. That is scenario based. If you are going to create that application you are going to have to know some things. You are going to have the Instructional Systems degree. It takes a lot of talent."

Participants with application development experience frequently mentioned the importance of developing templates for application development. Multiple training developers requested or identified the need for "standardized formats/interfaces" or "templates." One training developer suggested the need for "a GUI [graphical user interface] for standard Army interface, if I have an Army app I know where it is. Big Army needs to send that down the pipe. As a user I want the things in the same place. The apps that I like, it's because I know the buttons are in the same place." Some participants referred to templates created by the Mobile Applications Branch. Some training developers suggested that they have moved beyond those templates: "We have changed from the Mobile Applications Branch template to ours. It would be good to have a repository of standard templates."

Implementation. This subfactor concerns the implementation of applications in training, including training on how to use the application and the introduction of applications to students. Multiple comments suggested the importance of providing training to "both instructors and students on how to use device." Instructors and students need to receive training on how to use devices and applications in order to maximize the effectiveness of both. One training developer described how training can be provided for instructors and to the benefit of training: "Frequently end up creating a paper-based handbook to read for how to use the device/app. Apps can teach basic tasks and instructors can focus on more advanced things." An EBOLC student said, "There was none [training]. We were issued the tablets. They didn't say don't do this. They said play with them. There was no one who said this is new to you and those people didn't use the tablets. [It would be beneficial] if they could have spent 2 hours on familiarization with the functions and apps, capabilities and how to download apps."

Students and instructors displayed negative attitudes toward applications if the applications were not effectively demonstrated: "There were some apps, but no one went over them. They were just there as junk apps. If we had an explanation or they put something useful on it that might help. The junk is just more to sift through."

Information presentation: order of presentation and media selection. This subfactor concerns how information should be presented in applications. Topics within this subfactor include considerations for text based vs. graphic based vs. audio based information presentation, the use of scaffolding, or linear vs. adaptive user progression through the application. Linear presentation consists of a fixed narrative or progression through an application, whereas adaptive progression refers to applications where the user experience is more open or free and progression through the application depends upon decisions made by the user. Participants frequently commented about information acquisition and believed that different media choices affected the

value of the application. Participants tended to prefer rich media that incorporates video and/or audio over applications that more resembled a traditional briefing. One training developer said the best formats were "things like video based training, searching through forums, YouTube video." Another training developer said, "Process videos as podcasts and vodcasts." In terms of text based applications participants favored using "tabs and hyperlinks" to make the application more interactive. Some participants suggested "incorporating GPS"; however , "Apps that require network access are more buggy and difficult."

Some participants described various types of formats, but nearly all particularly mentioned avoiding PowerPoint. One participant described the desire to go beyond PowerPoint presentations: "Sustainment Center of Excellence Mobile or (SCoE) Mobile is trying to emphasize more than just PowerPoint format." SCoE Mobile is the Army's center of excellence for mobile application creation and the design of applications for instruction. Another training developer discussed the failure of PowerPoint to be easily updated and therefore it becomes outdated: "Delivering a PowerPoint (PPT) presentation. Apps that allow you to open a PPT are not good because you could end up with an outdated version. Word files are the same way." Another training developer described a way for linking applications to content that would allow for content to be updated: "Sponsors who want an updated newsletter, but don't know how to or have an ability to have a repository of the content. Development is easiest when an external website or data source is updated separately from the app, but the app just knows where to go get the most recent data."

Participants suggested that interactive and entertainment aspects of applications could be used to motivate learning. One participant said, "If it looks like a game then you will have a positive reaction. For example, modeling a block of instructions after a first person shooter game."

User interaction. This subfactor concerns how users will interact with applications. Considerations included the necessity of voice interaction, haptic interaction via a touch screen, text entry, visual interaction (e.g., viewing training multimedia), collaboration between students, or network interaction. Despite the proliferation of apps available, the discussion of user interaction suggested that the design of innovative user interaction involving mobile devices, particularly for Army training, is still in the early stages. One training developer said that they were "looking at coming up with a game that allows students to play against each other." Several training developers described the difficulty in producing more complicated technical applications. One training developer said development was a "two or three year process, multimillion dollar process. By the time the simulation is done and completed, it is obsolete." Another training developer described user expectations: "Soldiers expected quality of content presentation to be at the level of commercial gaming or simulations – while quality and fidelity are important, the content must be current and accurate." The emergence of new technologies and increased experience of Army training developers will eventually lead to technically complex applications that allow multiple users to interact. However, the current capabilities and cost realities make it difficult for these types of applications to be designed at present.

Usability. This subfactor concerns the user friendliness (an aspect of usability which can negatively impact user acceptance of an application) of applications and other aspects such as

application functionality and user interface. In the survey, participants were asked to consider what is important for decision makers when determining how to integrate digital applications and mobile technologies into AIT. Specifically, participants were asked to identify the importance of usability of the device/application (e.g., user friendliness, screen size, ease to program/set-up, etc.). 90.2% of participants responded that usability was either important or very important. Only 4% of participants responded that usability was slightly important or not at all important.

User friendliness. Whether the application works well or functions correctly was mentioned several times. One student said, "The interface, if the software is not user friendly for those who are messing around with it, it discourages you from playing around and figuring it out. I was excited at first, but then it got frustrating fast." Several students described the lack of user friendliness as a key determinant to whether or not they use the device. One student describing an application reference material said, "The pdf reader, I took mine to be re-encrypted and it crashed four times." Another student said, "I might spend 4 or 5 min looking for something and never get there. If I'm not going to get anywhere I won't use it." A training developer said, "If it is not user friendly I am not going to use the device. As far as an app, I like to make it look pretty, but if I am a user I don't care how it looks as long as it is quick. I don't want it hid somewhere. I am going to get out and do something else."

The simplicity of applications in terms of navigating and the ease of use were discussed as important to user friendliness. Participants suggested that user friendliness was most important or among one of the most important considerations concerning training using mobile devices. One instructor described how applications that lack simplicity, intuitive controls, and timely application execution will lead to a lack of use: "It has to be simple. If it takes a minute to get into with a bunch of things to jump through, their attention span is gone. The current generation wants instant results and gratification."

User motivation. Participants described the need to motivate trainees to use applications. One instructor said, "Because it is not written into the POI, it is limited to the Soldiers' motivation." Another participant said, "However, getting them motivated to do it is hard. It's too complex and a lot of them will just give up. If you broke it down it would be more effective, though it has been effective." Describing the challenge of getting trainees to engage is self-directed learning, one participant said that "to get them to want to learn on their own time is hard."

Many participants commented on how if applications were fun or entertaining then they would increase trainees' motivation to use applications and learn. One training developer said, "You can't [always] make apps mandatory, but if you make it fun, they will do it." Another participant said, "It has to be entertaining. They get excited at first, but they get bored quickly. You can put it out to them and say why don't you use the device. None will do it unless it is more entertaining." Additionally, instructors can use applications and mobile devices to increase classroom motivation. One student said, "I don't think a lot of the instructors had an issue [with devices] because it was an opportunity to liven up the classes. We think the classes are dull so I'm sure they think that."

Several participants suggested methods for increasing trainees' motivation to use mobile applications. One training developer said, "You have one goal with little tiny goals. You need

the little rewards. That is what the little games are used for, to keep them going along." Another training developer similarly commented, "In application, replicate achievement/competition component to motivate (Scores, medals, etc)." Another training developer described the value of demonstrating the training effectiveness of applications: "Show them or demonstrate a capability that enhances their effectiveness and Soldier performance. [Some app and device tests] have shown great improvements in training and task performance. Take advantage of parallel gaming presentations and graphics to increase Soldiers' interest and motivation in the training."

Utility-Value. This subfactor concerns the value associated with applications, such as improved motivation of trainees, improved skill transfer to work tasks, reduction in errors, etc. In the survey, participants were asked to consider what is important for decision makers when determining how to integrate digital applications and mobile technologies into AIT. Specifically, participants were asked to identify the importance of utility of the device/application (i.e. how effective the device/application is for doing what needs to be done). 98% of the participants responded that utility was either important or very important. No participants responded that utility was slightly important or not at all important. Participants described utility as one of the most important aspects concerning mobile learning. The usefulness of applications and devices were discussed in terms of their effect on training and also their overall cost effectiveness.

Training effectiveness. Many participants described the need for more information concerning the effectiveness of mobile applications and devices. One participant said, "The instructors haven't been convinced that it is worth using." Another participant said, "If you have relevant apps that make you a better Soldier then yea what instructor doesn't want that." Specifically, a participant referenced the need for data which demonstrates that "you are going to [be] better, based on quantifiable data." Participants suggested that it was important to demonstrate the effectiveness of using the mobile devices and applications. In discussing training effectiveness one participant suggested that data is already demonstrating that mobile devices are effective. For example, a civilian with mobile learning experience said that a mobile learning pilot of a Raytheon devised application for AD AIT – patriot missile AIT at Ft Bliss – resulted in completing class approximately 2 weeks early with 14% increase in grade point average. Another participant indicated there had been a "50% increase across board in academic performance."

Cost effectiveness. Participants suggested that the cost effectiveness of applications and devices was important. One participant said, "Cost is a big factor. Cost-effectiveness [how much it helps compared to how much it costs]." Numerous participants identified benefits of mobile devices that they believed contribute to the cost effectiveness of devices. One participant said, "Mobile devices could eliminate the need for paper, more instant compilation of textbook." Another participant said, "I think it can be effective. We have 10 radars to work with. Other groups only have one radar. So equipment time is limited. Students are going to be getting a lot of time. Giving students time digitally instead of on paper will reduce learning/training time and reduce paper costs. The new generation will learn it just a little faster, not to mention saving paper costs. We have to print out TMs, manuals. Now you are doing one sum cost and update the software as changes come." Finally, one participant suggested that for mobile devices to be truly cost effective they would need to be used more in training: "I would say there is [return on investment] ROI, but I would want it to have more for how much they spend per unit. I would

want it to be more than just march, order, and emplacement (MOE) because that is a small piece of our course. I think the capability could be expanded to other aspects of the course."

Compatibility. This subfactor concerns the compatibility of applications with one or multiple devices or operating systems. Participants wanted to make sure that application compatibility was considered because users have preferences for different devices which contain different programing languages. One student said, "I have an iPad. You go down IOS or Android, most apps are published on both. If they could get the developer license they could do both." A developer said, "When we were choosing phones we selected (Android) phones because we can stick flash media in. Itunes uses the Itunes format so it's not compatible with our stock footage. That flash was not user friendly."

Training Context

This factor focuses on the actual training environment. There were a total of 18 participant comments for the *Training Context* factor. There were four questions in the survey related to the *Training Context* factor. Three subfactors were identified that helped classify the most important considerations for this factor. Table 6 summarizes the subfactors and the number of participant comments for each subfactor.

Table 6
Training Context Subfactors Comments

Subfactor	Number of Participant Comments
Classroom	4
Field/Range	7
During Personal Time	7

Classroom context. This subfactor concerns the use of handheld mobile devices and training applications in a classroom setting. In the survey, participants were asked to identify the effectiveness of digital application and mobile technologies in various training contexts common to AIT. Specifically, participants were asked to rate the effectiveness of digital applications and mobile technologies in classroom instruction. 61% of participants responded that digital applications and mobile technologies were either effective or very effective in classroom instruction in AIT. 14.6% of participants responded that digital applications and mobile technologies were either ineffective or very ineffective in classroom instruction in AIT.

Participants suggested that both tablets and smartphones were appropriate for classroom training. Tablets were most preferred by our participants for training conducted in the classroom. One training developer said, "some needed smartphones, while others needed tablets, especially in the classroom." Participants mentioned the value of having tablets in the classroom as a reference. One participant appreciated the ability these devices have to manage greater amounts of information and number of terms. An instructor mentioned, "The onus is on the student to bring it with them. If they have it, I let them reference it." The instructor also warned that the reference material has to be easy to access as the pace of the course requires students to search quickly through materials.

Field context. This subfactor concerns the use of handheld mobile devices and training applications in a field or range context. In the survey, participants were asked to identify the effectiveness of digital application and mobile technologies in various training contexts common to AIT. Specifically, participants were asked to rate the effectiveness of digital applications and mobile technologies in field instruction. 70% of participants responded that digital applications and mobile technologies were either effective or very effective in field instruction in AIT. 17.5% of participants responded that digital applications and mobile technologies were either ineffective or very ineffective in field instruction in AIT. Additionally, participants were asked to rate the effectiveness of digital applications and mobile technologies in concurrent training. 78.6% of participants responded that digital applications and mobile technologies were either effective or very effective in concurrent training. 11.9% of participants responded that digital applications and mobile technologies were either ineffective or very ineffective in concurrent training.

Participants suggested that both tablets and smartphones were appropriate for field training. However, there were some reservations as to what types of field training conditions were appropriate. Device durability was mentioned as those involved with physically challenging field contexts questioned the ability to have devices in the field. One instructor said, "I couldn't take them [tablets] on my demo range. They are banned from there because I don't want them broken. Our exercises are hands on." For the same reason, participants suggested that mobile devices might be less appropriate for field training exercises. One student said, "We are not allowed to take these to the field at all. When we go on FTXs [field training exercises], we can't take them because if they get wet or dropped they're done."

Several participants described the value of having mobile devices in the field. Participants mentioned that devices would be helpful in delivering information and practice to Soldiers who are waiting to receive more one-on-one instructor-led training or hands-on training on a piece of equipment. One participant detailed how this type of training could be conducted: "We break down our AIT into modules. Learn how to drive the Hemmet. Then break down the launcher, then the MOE crew drills. If you broke the app down like that and they followed along, how many can an instructor do at a time, 4. If I can only do 2 at a time, in the bleachers they can be learning what the gauges do. Then in module 2, [while] I am teaching 2 people, they can be sitting there practicing."

During personal time. This subfactor concerns the use of handheld mobile devices and training applications to be used in one's free time as self-development (e.g., the barracks). In the survey, participants were asked to identify the effectiveness of digital application and mobile technologies in various training contexts common to AIT. Specifically, participants were asked to rate the effectiveness of digital applications and mobile technologies in informal instruction. 82.9% of participants responded that digital applications and mobile technologies were either effective or very effective in informal instruction. 9.7% of participants responded that digital applications and mobile technologies were either ineffective or very ineffective in informal instruction.

Several participants emphasized the value of having the device for review of training materials, but that in order for self-directed learning to work the devices need to be engaging and

the materials need to be relevant to training. One student said, "Not just a task, but more of a mode of learning. When you take home the device at night you aren't likely to break out 6 different FMs but if it is more interactive they are going to be more likely to open it up and check it out again, to review or reinforce their learning. That would cut back on training time if people were understanding things faster." Participants described the value of having the device for use in the barracks. One training developer said, "They had reinforcement training after hours. This was to refresh."

Training Content

This factor concerns the development of applications, including lessons learned and recommendations on how to develop applications for handheld mobile devices (e.g., expected time investments, expected barriers, application development process recommendations, etc.). There were a total of 79 participant comments that focused on this factor. There were five questions in the survey related to the *Training Content* factor. Seven subfactors were identified that helped classify the most important considerations for this factor. Table 7 reviews the subfactors and the number of participant responses for each subfactor.

Table 7
Training Content Subfactors Comments

Subfactor	Number of Participant Comments
Objectives	20
Content complexity	13
Content constancy/stability	5
Individual/Collective task	9
Resource Requirements	11

Objectives. This subfactor concerns the objectives of training according to the POI and course goals. The focus here is on determining what the training is intended to accomplish (i.e., successful trainees are those who are able to…?). In the survey, participants were asked to consider what is important for decision makers when determining how to integrate digital applications and mobile technologies into AIT. Specifically, participants were asked to identify the importance of the objectives of the training (e.g., training objectives versus learning objectives). 85.4% of participants responded that the objectives of the training were either important or very important. 4.2% of participants responded that the objectives of the training were slightly important or not at all important. Additionally, participants were asked to identify the importance of the nature of the learning opportunities and what the focal intent of the training is on (e.g., knowledge, skill acquisition, practice, and feedback). 91.8% of participants responded that the nature of the learning opportunities and what the focal intent of the training is on was either important or very important. 2% of participants responded that the nature of the learning opportunities and what the focal intent of the training is on was slightly important or not at all important.

Training and learning objectives need to be well defined to make development of mobile applications easier. One application developer suggested that the program of instruction (POI) needs to be established for application developers to begin creating an application: "Analysis of POI needs to be done and rewritten. They [(application developers] don't have time to do the POI. Training developers do the POIs. They are trying to work the pieces of getting resources into redoing lessons plans." Also, once the application is completed the content needs to be reviewed and tested: "Issues with the content itself [some of the steps were incorrect or backwards]. I don't know if we had a beta version. Need to review the content for accuracy. It is helpful to learn but it has to be the right thing." Additionally, training and learning objectives need to be defined with instructors' direct involvement to ensure that what is being developed will be of value to them: "For it to be effective it has to be worked into the POIs with the instructors. The programs have to be simplified and appropriate for that POI."

In the survey, participants were asked to consider what is important for decision makers when determining how to integrate digital applications and mobile technologies into AIT. Specifically, participants were asked to identify the importance of the knowledge, skill, and psychomotor requirements of the MOS being trained. 81.6% of participants responded that the knowledge, skill, and psychomotor requirements of the MOS being trained were either important or very important. 10.2% of participants responded that the knowledge, skill, and psychomotor requirements of the MOS being trained were slightly important or not at all important. Participants suggested that the development of applications and decisions concerning what course content should be considered for development is MOS specific. One participant said, "It depends on what it is for. Different MOSs would require different things." Another participant said, "Consider the nature of the skills, ability of students in AIT, the rough and tumble is hard to control. The group that is willing to sit and listen. The chemical school it is chemistry, some physical science. You have to do an analysis of a course. One size does not fit all."

Several participants suggested types of military occupational specialties (MOSs) and training objectives where mobile learning would not be suitable. Instructors mentioned that they wouldn't be useful in field settings like a demo range. Another participant suggested that the hands-on nature of training made the use of mobile devices less valuable: "Ours [training] is repetition. The hands-on training is what is going to make them perform well on their job. The iPhone isn't going to get them motivated. When I am telling a Soldier to MOE four times a day I need him to be motivated. The hands-on is what gets them through it, the battle buddy, camaraderie, making it a team effort." However, several participants believed that mobile devices would be helpful in certain types of hands-on situations. For example, one training developer said, "Yes, some you need to get your hands [involved with equipment], on that stuff an application won't help, but if I have a 3D model of the thing that I can drill in and look at the whole things without touching a brake system (i.e., of a vehicle). That would be beneficial. I can drill down and see the parts without breaking the brakes. I keep that in a step by step app and take it with me. Then I have it for later. I can see its usefulness." One instructor suggested a blended training context that would make mobile devices improve upon the hands-on experience: "There is no way to replace hands-on training. One area that is enhanced is MOE training. Maintenance, it would be cheaper on an app than hands-on because maintenance costs for the Patriot are unreal. The MOE portion for that, it is a great tool. It puts a picture to the steps.

Prior to this, we read through the training circulars (TCs), but didn't get to do it until we got to the later hands-on phases. They weren't getting hands-on until the walking phase. This almost puts us at a walking phase earlier. Gives them better visualization of what they have to do and when they have to do it. It cuts down time when they actual do the hands on training during the run phase."

Participants suggested several objectives that are suitable for training with mobile devices. The most basic objectives were things such as doctrine and course material references. One student said, "Field manuals and training manuals on the phone would be great." Another participant suggested that technical MOSs would benefit most from mobile learning: "More technical MOSs would be better served using technology. But all MOSs are getting more technical." Several participants mentioned specific MOSs or examples of training objectives where the integration of mobile learning could benefit training such as medical MOSs, Infantry and Squad tactics/movements, equipment diagrams (e.g, perhaps through augmented reality), military decision making process (MDMP), Army form familiarization, Physical Readiness Training, bridge crossing calculations, rifle marksmanship visual training aids, supplement or replace hip pocket training and aids, etc.

Content complexity. This subfactor concerns the complexity/simplicity of content for the specific task being considered for the employment of handheld devices and digital applications. The issues of technical development difficulty and content complexity were somewhat interrelated. First, participants made suggestions concerning how technical development should be approached concerning difficulty: "Look at in-house capabilities – as apps get more complex, units might not be capable of doing this – have to outsource." Another participant suggested that applications should not become too complex because they are "not meant to replace IMI."

Participants suggested that the type of content selected for application development should be simple. One training developer said, "Apps work well for simple skills that simply take time to learn (versus elaborate explanation or more involved training)." Another training developer said that applications work best for training on "equipment, procedure, protocol." Similarly, another training developer said, "Standardized procedures [work well as applications] versus ill-defined problems with lots of solutions."

Content constancy/stability. This subfactor concerns the constancy/stability associated with the content related to a particular MOS or program of instruction (POI). For instance, training in which the operational environment rapidly changes may require continuous training content updates. Participants provided several comments that suggest that it is important to develop applications for content that is relatively constant or permanent. One participant described the challenge of remaining current while focusing on more established training content: "The longevity of information (life expectancy of information). It's easy to get caught up on new shiny object. A lot of what we have becomes obsolete, so it takes longer to update application than [you have] to use it. Certain tactics will always remain the same (M-16 breakdown will always be the same). Generic type of training is more useful (IED may not be useful because it constantly changes). Applications can be used for content that doesn't change routinely. PT is another example of something that doesn't change. We can't keep up with

constantly updating changes. If we can't keep up with rapid change, we can't keep Soldiers up to date with the most recent iteration." Another participant described the difficulty in changing an application to keep pace with changes in training content, it "…depends on what you are doing. If we are going to make huge changes to application, it is going to take some time. We are very comfortable for using an application for crew drills. Communication equipment (something that changes a lot) may not be as cost-effective or practical for applications."

Individual/Collective task. This subfactor concerns whether or not the application is for individual or collective tasks. One of the most frequent subjects that participants commented on was the desire for interactive, collective learning using mobile applications. One training developer said, "Mobile devices can allow for more realistic scenarios in distributed teams." Another participant said, "Number one thing that was asked for was the interactive play. All of our equipment requires more than one individual crew member. If we could have one person on one phone driving and the other person navigating, it would have been more realistic. In the real world there is constant interaction. They are used to interfacing digitally and it would make the training more realistic." Participants tended to value the ability to collaborate and displayed a desire to work in collaborative training environments. One student said, "Forums would be cool where you could post things live and go over things with those in your group. That would be very beneficial."

Participants did suggest certain limitations to developing applications for collective training. One instructor described the cost of developing applications that are collaborative or interactive: "Working with others (i.e., crew drills). If you are working with 2 or 3 other people. We requested a multiplayer app, but if our budget limits us to do single player, then we can't do crew drills, we have to play with a computer. Human interactions are more difficult to simulate through an avatar. If I am training with a computer and then move to a person it will be different. I have to get an experience of what it is like to work with that person." Another instructor described training context where individuals have defined roles and suggested that an understanding of individual tasks and responsibilities are required before moving on to collective learning: "Single player simulations make people learn their own job, but if you use multiplayer apps, people may not be focused on learning their own task."

Resource requirements. This subfactor focuses on the resource requirements (e.g., equipment or range) associated with training. As an example, training that necessitates the use of special equipment would specify this equipment as a resource requirement for effective training. In the survey, participants were asked to consider what is important for decision makers when determining how to integrate digital applications and mobile technologies into AIT. Specifically, participants were asked to consider the importance of the requirements of the specific task being trained (e.g., some tasks may require the use of a student's hands making it difficult to hold the device and perform the task). 88% of participants responded that the requirements of the specific task being trained were either important or very important. 6% of participants responded that the requirements of the specific task being trained were slightly important or not at all important. Additionally, participants were asked to identify the importance of the availability of training resources, especially operational equipment, ranges, and simulators. 87.8% of participants responded that the availability of training resources, especially operational equipment, ranges, and simulators was either important or very important.

2% of participants responded that the availability of training resources, especially operational equipment, ranges, and simulators was slightly important or not at all important.

Most of the comments concerning resource requirements described the utility of mobile devices in a blended learning environment to make up for a shortfall in resources, such as equipment. One participant said, "The crawl phase. There is not enough equipment for hands on as much as we want. Getting the equipment is usually the biggest problem. Mobile apps help with that. It will save us money on maintenance costs. If we can avoid some of the crawl costs it will be a plus for the Army." Lastly, an instructor described how mobile devices could overcome training delays: "One example to add on was that last week, the class was scheduled to do hands on training for MOE but it was inclement weather, so we had them come in and train via the mobile apps. The next day they were scheduled for the hands-on portion [but they couldn't because of the weather] and it's like they were training [when they used the application]. Normally, this would make you behind schedule but they remained on schedule."

Students

This factor concerns issues related to students' use of handheld mobile devices or digital applications. There were a total of 46 participant comments for this factor. There were three questions in the survey directly related to this factor. Two subfactors were identified that helped classify the most important considerations for this factor. Table 8 displays the subfactors and the number of participant responses for each subfactor. Each subfactor is listed below with supporting evidence extracted from interview and focus group data.

Table 8
Students Subfactor Comments

Subfactor	Number of Participant Comments
Attitudes/experiences with devices/applications	30
Readiness for self-directed learning	10

Attitudes and experiences with devices/applications. This subfactor concerns the general characteristics, individual differences, and learning orientation of students in AIT. Examples of characteristics, individual differences, and learning orientations include, but are not limited to: age, self-efficacy, and goal-setting skills, respectively. In addition, this subfactor concerns AIT students' attitudes toward mobile devices (e.g., preferences for or against a particular handheld mobile device or handheld mobile devices in general), previous experiences with handheld mobile devices (e.g., number of handheld mobile device experiences and valence of those experiences), and readiness for self-directed learning (e.g., are the students motivated to use devices and applications on their own time to enhance knowledge and skills).

In the survey, participants were asked to consider what is important for decision makers to consider when determining how to integrate digital applications and mobile technologies into AIT. Specifically, participants were asked to identify the importance of the student's level of motivation and learning orientation. 74% of participants responded that the student's level of motivation and learning orientation was either important or very important. 10% of participants

responded that the student's level of motivation and learning orientation was slightly important or not at all important.

The main characteristic that was discussed concerned the "younger" generation, referring to new and future AIT trainees, who are capable and favor mobile devices in learning because of their familiarity with mobile devices. One student said, "especially with this generation, [mobile learning] is very effective because of the way our generation has been raised to operate is with electronics, free time with games or at school with a computer. As technology is developing, it has great potential to affect the quality of education we receive at MOS in a way we can relate to and therefore will remember better." A commander contrasted the familiarity of the younger generation with the difficulty that those who are older might have using mobile devices: "The group that we are targeting is young and are used to the iPhones and smartphones. For them, it is a good idea. However, we have older folks who are not used to such devices. For them it is not the way to go."

Comments suggested that mobile learning may reach out to a segment of the trainee population that is more difficult to reach with traditional learning methods. One instructor said, "I am not really sure how to identify who will be motivated to do it. The ones that tended to take less notes, daydream, and less involved students used it more. The ones that just do enough to pass, they were more involved than others." Even though students may be more familiar with the devices, the training still needs to be reasonably easy to comprehend. One participant remarked that the mobile devices have value "for those that are videogame savvy."

In the survey, participants were asked to consider what is important for decision makers when determining how to integrate digital applications and mobile technologies into AIT. Specifically, participants were asked to identify the importance of the student's background and experience. 28% of participants responded that the student's background and experience was either important or very important. 38%% of participants responded that the student's background and experience was slightly important or not at all important. Students tend to have familiarity and experience with mobile devices, although experience will vary. One student said, "I didn't have a computer until 8th grade. These kids had them in elementary school. 99% have a smartphone. Their comfortability is higher." Age was used as a means for describing differences in familiarity with devices. One student said, "The older generation didn't have quite the immersion in technology that we did. There was an older individual who was a little slow on the uptake, but this individual eventually got it. Some people who have already been in the military a while may have trouble, but the younger generation Soldiers are likely to pick up on it faster." Familiarity with devices was also identified as related to attitudes toward devices. One participant said, "In my class I had a wide spectrum of those who use it a lot and those who haven't used it at all. I think familiarity is important. The people who have not used it are not familiar with the technology (not tech savvy)."

In addition to experience with device, some participants displayed negative attitudes toward devices due to the cost of the device. Some participants discussed negative issues regarding responsibility for the device. One training developer said, "Some students don't want to sign for the equipment and take the risk of breaking or losing them." Device cost and responsibility for the device were concerns mentioned alongside the fragility of devices. Despite

concerns over the device, if precautions were taken to increase device durability and Soldiers saw the value of devices, then they were responsible for the devices. One training developer said there was a "fear that devices were fragile. Found if Soldiers see military utility of the devices, they will take care of them (because they value them). Added low-end covers and screen protectors; but relied mainly on Soldiers' common sense. Out of 100 devices used at Bliss, only 2 destroyed or damaged in 2 yrs – devices were still usable with cracked screens."

Readiness for self-directed learning. This subfactor concerns the amount of experience AIT students have prior to using a mobile learning device in AIT. In the survey, participants were asked to consider what is important for decision makers when determining how to integrate digital applications and mobile technologies into AIT. Specifically, participants were asked to identify the importance of the maturity level of students. 60% of participants responded that the maturity level of students was either important or very important. 14% of participants responded that the maturity level of students was slightly important or not at all important. Student maturity level is related to the level of responsibility and seriousness that are required in order to be ready for self-directed learning. The individual characteristics and attitudes of trainees would suggest that individuals are ready for SDL. Additionally, a cultural shift to using mobile devices would normalize the use of devices in training. One training developer said, "Good modeling. If more people start to use them, if influential people sell the use of mobile devices, it will help to overcome hesitation. Seeing what devices can do, becoming a believer. Peers showing/teaching people how to use devices."

Participants recommended training to help integrate devices and prepare trainees for the responsibility of SDL. One training developer said, "The solution – train Soldiers on how to use devices and when; as well as when not to use them (but keep restrictions reasonable and consistent – with appropriate follow-through). Personal experience indicated that Soldiers did not abuse privilege and access, rather they were more able to identify additional means to exploit the technology for mission and training." Another commander described how device training can improve user attitudes: "For AIT, we provided them with a crash course on how to use the phone. Some have caught interest in liking it. Someone younger who likes it if you stick them with someone older then they may like it. If they don't like it though, then they won't use it. Perhaps pairing individuals who are comfortable with those who are not might help."

Instructors

This factor concerns the issues related to instructor attitudes, experiences, preferences, and roles in using handheld mobile devices in training. There were a total of 47 participant comments that focused on the *Instructors* factor. There were two questions in the survey related to this factor. Two subfactors were identified that helped classify the most important considerations for this factor. Table 9 summarizes the subfactors and the number of participant responses for each subfactor. Each subfactor is discussed below with supporting evidence extracted from interview and focus group data.

Table 9
Instructors Subfactors Comments

Subfactor	Number of Participant Comments
Experience/attitudes toward device	26
Role in Training	9

Experience/attitudes toward device. This subfactor concerns the experiences and attitudes that instructors have toward handheld mobile technologies and their use in AIT. In the survey, participants were asked to consider what is important for decision makers when determining how to integrate digital applications and mobile technologies into AIT. Specifically, participants were asked to identify the importance of the background and qualifications of the instructor conducting the training. 72.5% of participants responded that the background and qualifications of the instructor conducting the training was either important or very important. 13.7% of participants responded that the background and qualifications of the instructor conducting the training was slightly important or not at all important.

Instructor attitudes varied regarding their opinion of mobile devices and mobile learning. Many instructors saw value in mobile learning. One participant said, "All instructors seem to agree that the app itself is great." One training developer identified common skepticisms among some instructors: "[instructors] see mobile devices as temporary flavor of the month." Participants pointed out the comfort that instructors had with traditional instruction and that inexperience was a source of skepticism regarding the potential benefits of mobile learning. One participant said, "The biggest barrier is the older generation wanting to do things the way they [the instructors] have always done them. It's hard to get instructors out of their comfort zone."

The biggest issue that was raised was a general resistance among instructors to change. One commander said, "Like anything else, the initial change is difficult. A lot of my instructors do not like the change. I think they feel that they are being replaced by a phone. Initially they are pushing back and they don't get to see the bigger picture. It is helping a lot of people. Yes it does cost money like anything else. But once it is implemented, they will accept it and move forward." One participant identified the source of instructor resistance to change as "related to level of comfort with technology. If an instructor is set in their ways, they might ask, 'Why deal with it?'" Some already think they are successful doing it how they've done it."

Several participants suggested fear of the unknown or irrational fear as a barrier to improving instructor attitudes about mobile devices and learning. One participant identified a "fear of computers" as a potential source of concern, while another suggested that there is "fear that instructors will be lost because phones can replace people." The most frequently discussed fear was the fear that instructors would lose control over information. One training developer described it as, "fear of [the] unknown; a cultural change especially among NCOs, information has always been power – smart phones gives everyone access to information, which challenges the current status quo of control." Another training developer said, "Soldiers set up their own communication groups to share and exchange information; some NCOs resisted or reacted negatively due to a lack of control of the exact information being shared by the Soldiers."

Lastly, a student identified the rationale behind this fear, "The NCOs' power is by knowing more than the Private. When you give the Private something where he knows more, the NCO is not going to use it."

Perceived benefits to instructor. Participants suggested that it was important to get buy-in from instructors in order to implement mobile learning effectively. One training developer recommended, "We need a PR campaign to get buy-in." One participant identified that the major obstacle is that "instructors need to be motivated and capable." Several participants made suggestions that may increase instructor motivation and capabilities concerning mobile learning.

The chief method for increasing instructor's motivation to use the device was to clearly demonstrate the effectiveness of mobile learning. One commander said, "It is mainly explaining to them the benefits of the change. It is also important to let them know that it is not going to help everybody, but it will help some." Several participants identified a change in instructors after they were able to see the capabilities or value of mobile devices in training. For example, one instructor said, "I did what I was told, but I wasn't completely sold until the one inclement weather class where they couldn't use the hands on equipment and I saw that students were able to grasp concepts. Then I was completely sold and I bought into it." Another student participant said, "[instructors] were skeptical in the beginning but after watching us they started to see the value. They saw us advancing further because we were able to get that base knowledge." Lastly, one participant described how impressing the instructors with the device and application's capabilities could increase buy-in: "[Instructors] putting it on their computer and being able to show a class a simulation based video that can be manipulated (ex. Google-Earth type of environment), see different things for maintenance. It would be useful and gain a wow factor."

In the survey, participants were asked to consider what is important for decision makers when determining how to integrate digital applications and mobile technologies into AIT. Specifically, participants were asked to identify the importance of the instructor's knowledge of mobile device capabilities. 82.4% of participants responded that the instructor's knowledge of mobile device capabilities was either important or very important. 5.9% of participants responded that the instructor's knowledge of mobile device capabilities was slightly important or not at all important.

Participants identified negative instructor attitudes which would suggest that it may be difficult to initially familiarize instructors to devices. For example, one participant said, "instructors/cadre are busy people" and another participant said instructors "will see it as extra work to learn." This was contrasted by another participant who said, "sometimes phone can help because it frees up instructor workload."

Participants described the importance of familiarizing Instructors to devices and suggested methods for doing so. One training developer said, "Give the instructor the device and let them play with it." Another training developer said, "Instructors should largely buy in on their own (newer instructors are more comfortable with technology and willing to use it). This really points to the importance of their past experience, especially with smart devices." Other

participants suggested that initial device orientation and training should be more involved. One training developer said, "[You] can't just give out smartphones and expect them to be used or embraced." An instructor said, "Make sure the instructors are competent on the piece of equipment. Rather than a 5 min spiel when they give it to us they need to teach us the capabilities and limitations. That makes us more likely to use it and the students to use it. It doesn't have to be a course, just a 30 min sit down, FAQ [frequently asked questions], I am decrypting and it won't open, what do I do. That way when we are hit with that we know an answer. If they know we are confident, students can come to us and if we are using it, they are using it. That would increase the efficacy of it." Due to the varied level of experience with devices and how busy instructors are, one participant suggested that instructors who need training to use mobile devices should be allowed to "follow his own training calendar on it." This would allow them to take training at their own pace and fit it into their schedule.

Many participants noticed that once instructors became familiar with the device their perception of the value of the device increased. One instructor said, "After seeing the true power and the bigger picture, and why we are trying to push IMI [interactive multimedia instruction] they will buy in to it." A student said, "We saw their opinions change. At first they were just compliant but then two to three days in, they started to see the value. We had a leg up on others. They told us to keep running with it because it seemed like it was working. We were able to go faster because we had a base underneath us."

Participants also suggested that instructors would have more buy-in and that implementation would be improved if instructors were involved in developing applications. One training developer said, "[There] has to be a combination of requirement to support it and high level support of the instructor's ability to shape the training around the device."

Role in training. This subfactor concerns how instructors expect to use the handheld mobile device in training. Examples of device roles include supplementing a lecture, as a communication device for instructors to contact students, or use as a demonstration or practice of necessary skills (i.e., a simulation). In the survey, participants were asked to consider what is important for decision makers when determining how to integrate digital applications and mobile technologies into AIT. Specifically, participants were asked to identify the importance of the instructor's ability to use mobile devices along with instructional practices. 92% of participants responded that the instructor's ability to use mobile devices along with instructional practices was either important or very important. 2% of participants responded that the instructor's ability to use mobile devices along with instructional practice was slightly important or not at all important. Additionally, participants were asked to identify the importance of the ability for cadre/instructors to control certain features of the device. 56.9% of participants responded that the ability for cadre/instructors to control certain features of the device was either important or very important. 19.6% of participants responded that the ability for cadre/instructors to control certain features of the device was slightly important or not at all important.

The participants suggested that in order to fully understand the role of mobile devices in training, instructors need to be trained on how to integrate the devices into their instruction. One instructor said, "With this application itself, we probably should have had a thorough forum with the instructors and developers to make sure everyone is prepared on the same page. Spending

time troubleshooting and reacting is time that could be used elsewhere. We've had phones crash. If we had instruction during a lunch hour it would benefit instructors."

Participants identified the value of having instructors use the mobile devices in conjunction with hands-on training. For example, one student said, "I can see it making the teacher's job a lot easier. They can tell us to run through an app on the phone to practice." Participants thought that mobile devices would be particularly effective in instances when there is a shortage of equipment. One student said, "Especially here where the equipment is limited during MOE, you are sitting and waiting, you can spend your time doing these apps during down time." Though participants mentioned the value of mobile devices in preparing for hands-on training, participants also warned against relying too heavily on the mobile devices. One student said, "I have heard some instructors say when everything falls apart there is still a way to do it. If you are so focused on technology, you won't know how. They will be deer in headlights. They don't want to do the harder way, but you have to because everything is shut down." This comment describes a fear that Soldiers would become overly reliant on technology and that without the technology, they would not be able to function. These comments suggest that mobile devices should not replace hands-on training; rather, mobile applications could help augment hands-on training.

Participants suggested that mobile devices would be valuable to instructors who were able to take advantage of device networking and trainee collaboration. One student suggested, "If they [instructors] could use Wi-Fi or even connect us through blackboard. Things like that can provide real feedback to the instructor." Another student said, "Setting up a network so you [other instructors] could monitor what is going on, on the tablets. He [an instructor] could do a check on learning, having people buzz in on an answer. We had systems like that in college." Lastly, a training developer requested other measures that instructors could use to monitor their students, "Still need measures and processes in place that provide feedback to the instructor (frequency of use, duration of self-study, areas of difficulty, etc.).

Institutional Support

This factor concerns institutional support in utilizing handheld mobile technologies for training. There were a total of 24 participant comments regarding this factor. There was one question in the survey related to the *Institutional Support* factor. Two subfactors were identified that helped classify the most important considerations for this factor. Table 10 displays the subfactors and the number of participant responses for each subfactor. Each subfactor is discussed below with supporting evidence extracted from interview and focus group data.

Table 10
Institutional Support Subfactors Comments

Subfactor	Number of Participant Comments
Broad-based support in Army culture	18
Support from Chain of Command	6

Broad-based support in the Army culture. This subfactor concerns the broad-based support in the Army culture for embracing and using handheld mobile devices in AIT or training in general. Many participants identified issues with regards to broad-based support in the Army culture. One participant identified a way of overcoming challenges or barriers to implementing mobile learning: "It has to be top down. The top has to push down that intent and make it happen. Saying 'it's great, make it happen' isn't helpful." Participants identified many problems arising for not having a top down approach to implementing mobile learning. One participant, referring to a lack of technical standards said, "We have received pushbacks saying we can't buy iPhones because the Army does not approve them. So whose approval do you need? The top officials either need to make the decision or to give discretion to make those decisions." One instructor noted the difficulty in getting approval to change the POI to include the use of mobile devices: "Any POI change has to be approved at multiple levels and takes a while for a revision on POI."

Participants identified cultural issues in understanding Army goals concerning mobile learning. One training developer identified barriers to reaching the Army's mobile learning goals: "The Network Enterprise Center (NEC) is the last say on this. They don't understand [ALM]. FY14 is the pilot for testing [ALM]. The same thing as the CSDA we are waiting on rules to change to stand up [ALM] when TRADOC is the only one interested. Support from outside is not there." Another training developer described what the focus should be moving forward: "What do they want to understand – main thing curiosity, and innovation and what your limits are – Army learning model 2015 is our guidepost. Things need to be done in 2012 to reach this goal in 2015. Set aside money and resources for developing toward that."

Participants suggested that cost and time requirements for implementation were issues. One participant described the issue of time: "The biggest problem is time. We are constantly moving and it is hard to sit back and focus solely on embracing the technology. I don't think there is a problem with the concept at all. Finding time to discuss/understand mobile app use and implementation is the hardest part." Additionally, participants mentioned cost as an issue given the current environmental context. One instructor said, "Money issues are present. We are going to have to tweak the programs to fit the budget. It's all about the money." A training developer said, "[some have] concern that apps will cut the budget, [that] will cause resistance (less need for funding to do same big course if apps can cut personnel or training time)."

Support from chain of command. This subfactor concerns support from the Chain of Command for using handheld mobile devices in AIT. In the survey, participants were asked to consider what is important for decision makers when determining how to integrate digital applications and mobile technologies into AIT. Specifically, participants were asked to identify the importance of leadership support for implementing mobile devices for training. 90% of participants responded that leadership support for implementing mobile devices for training was either important or very important. 2% of participants responded that Leadership support for implementing mobile devices for training was slightly important or not at all important.

Most participants identified that commanders are buying in to the idea that mobile devices and their corresponding digital applications can be beneficial for training. One participant described the buy-in: "Our battalion commanders now really pushed and embraced it.

They are the ones that really embrace it. Anything that can help us put a better product out, they are happy to help with." Another participant said, "Higher chains of command are happy to try something new that is supposed to be beneficial or if it enhances training." These comments reflect the importance of demonstrating that the devices are effective at enhancing training.

Participants also suggested the importance of getting everyone on board. One participant said, "A lot of support and drum-banging is needed. I am not sure how long that steam is going to maintain. The chains of command are currently diligent, but if you get one person who is afraid of technology then you are in trouble." A training developer said, "To get buy-in for using mobile technologies you need to have the entire command saying you will do this." The comments suggest that unanimous support from the chain of command will help in the implementation of mobile devices into training.

Device

The *Device* factor concerns device-related issues to better ensure successful integration of devices and applications into AIT. There were a total of 154 participant comments for the *Device* factor. There were four questions in the survey related to the device factor. Five subfactors were identified that helped classify the most important considerations for this factor. Table 11 displays the subfactors and the number of participant responses for each subfactor. Each subfactor is discussed below with supporting evidence extracted from interview and focus group data.

Table 11
Device Subfactors Comments

Subfactor	Number of Participant Comments
Device capabilities	42
Usability	12
Durability	10
Portability	10
Supportability	4

Device capabilities. This subfactor concerns the capabilities associated with various handheld mobile devices and the value of capabilities for mobile learning in AIT. In the survey, participants were asked to consider what is important for decision makers when determining how to integrate digital applications and mobile technologies into AIT. Specifically, participants were asked to identify the importance of the type of device (e.g., tablet versus smart phone). 66% of participants responded that the type of device was either important or very important. 14% of participants responded that the type of device was slightly important or not at all important.

Although data from SME [subject matter experts] interviews and focus groups suggested how all devices may have the potential to support mobile learning, an analysis of the data did not yield a clearly preferred mobile device. The data indicated that some individuals clearly preferred mobile phones: "I would prefer the phone because of its portability. I can take it

anywhere." While others clearly preferred other mobile devices such as tablets: "To me, using the phone seems kind of silly as opposed to the tablet," or netbooks, "We are looking at netbooks. The advantage is they are CAC [common access card] card ready…all of the problems of encryption have gone away."

In the survey, participants were asked to consider what is important for decision makers to consider when determining how to integrate digital applications and mobile technologies into AIT. Specifically, participants were asked to identify the importance of device capabilities such as memory, input/output, capabilities, connectivity. 80.4% of participants responded that device capabilities such as memory, input/output, capabilities, and connectivity were either important or very important. 3.9% of participants responded that device capabilities such as memory, input/output, capabilities, and connectivity were slightly important or not at all important.

Device preferences were largely grounded by the interaction between device characteristics and the training objectives and content. Specifically, the preferred device characteristics are determined by the training content and objectives, wherein the preferred device for one situation may not be the preferred device for another. As an example, one training developer stated, "Tablets worked best for leaders in field and generally in the classroom due to having to manage greater amounts of information and number of terms." In contrast, a student stated, "[The] computer is better for us. With apps and tabs [tablets] it is a singular path, with a computer you can do a lot more with that operating system. The tab [tablet] is useful when the task is simple." Major points of consideration related to mobile device preference (i.e., laptop, netbook, mobile phone, and tablet) are the previously mentioned device themes (i.e., device capabilities and usability, network connectivity, device display characteristics and features, and device portability). These themes are discussed below.

Usability. This subfactor concerns the usability of handheld mobile devices and the associated training required for effective use of devices. In the survey, participants were asked to consider what is important for decision makers when determining how to integrate digital applications and mobile technologies into AIT. Specifically, participants were asked to identify the importance of the usability of the device/application (e.g., user friendliness, screen size, ease to program/set-up, etc.). 90.2% of participants responded that the usability of the device/application was either important or very important. 4% of participants responded that the usability of the device/application was slightly important or not at all important.

In line with the discussion regarding the relationship between device preference and device appropriateness for training, the capabilities of a device largely determine decisions related to specific mobile device preference and usage, as well as the types of tasks amenable to mobile training. In support of this, one student specified that determining the most appropriate tasks for mobile training depended on the technological capabilities of the hand held device.When prompted with an inquiry related to the importance of capability relative to usability and utility, one student stated, "Capability [is the most important]. If it isn't capable of doing what we want, there isn't a point to it." In contrast, it should also be noted that the usability of the device was also referenced by numerous Soldiers as the most important device characteristic. Multiple Soldiers expressed the sentiment that if a device was not easy to use,

instructors would not buy-in to instructional use of the device and students would fail to see the benefit of the device: "if they don't see it as usable, the rest won't matter."

The remaining themes within the *Device* factor highlight specific device capabilities that these Soldiers were discussing. These themes relate to usability as well, for if the desired capabilities are not present, the device is not seen as useful. Specifically, the network connectivity capabilities, display capabilities, and device portability and durability determine whether or not a specific device is useful for training, as supported by Soldier comments.

Display. Numerous comments revolved around the issue of device display. Many Soldiers expressed concern over the small size of most mobile phones: "As far as the phone, the screen never seemed big enough. I would say a 7-10 inch screen on a tablet [is better]." A training developer supported this notion by saying, "Screen size is a big thing. In AIT, screen size, forget the phone. I have thrown that idea out the door. The tablet's screen size is wonderful." However, one should consider the relation of the desired task to the size of the screen. Specifically, for training tasks that rely on visual displays, mobile phones may not be optimal. When asked about barriers for implementation of mobile devices in AIT, an instructor responded saying, "The size of the iPhone was small. It is hard to see a real descriptive view of the equipment. If we move towards a table, it may be more beneficial." Furthermore, one Soldier stated that students loved the tablet because of the "backlit screen," a feature that is important if mobile device usage involves reading materials outside.

In addition to the size of the display for visualization purposes, training tasks that leverage the interactivity of touch screens must also consider the size of the mobile display. As one instructor stated, "If someone has big fingers, the phone won't do what you want it do to." A student provided a similar statement saying, "Having to tap the exact spot was difficult. A little more tolerance may reduce the need for a large screen. We knew where to hit, we just had to find that pinpoint." Further, multiple Soldiers stated that the size of the screen would influence the success of integrating mobile devices into training, stating, "It would be better to increase the size of the device like a tablet."

Network connectivity. Network connectivity was also a main focal point of many statements regarding the use of mobile devices. Numerous training programs have the potential to utilize networking capabilities, or in some cases necessitate networking capabilities for collaborative training tasks or sending and receiving information, such as field manuals. One instructor offered an example during the interview process, stating, "If we could download something like blue force tracker where you could get graphics maps, pinpoint your location, use it in orders and blast that out to other readers on a blue tooth that would be a good application in a FTX." It is clear that understanding the network connectivity capabilities of a mobile device in relation to intended use within a training context is essential. This notion was captured by a training developer who stated that "understand[ing] network requirements for full device capability and functionality" were extremely important.

During our interviews, it became evident that although numerous devices have networking potential, drawbacks exist with using certain mobile devices on the Army network. Multiple comments touted the networking capabilities of netbooks in relation to network

connectivity authority. Comments from multiple participants demonstrated that the current Army networking infrastructure supports the use of netbooks: "The advantage [of netbooks] is they are CAC card [capable]," are "approved to touch the .mil [network]," "can be used in/out of the classroom," and eliminate the problems of encrypting data; "all of the problems of encryption have gone away." Alternatively, other mobile devices, such as Apple's tablet, the iPad, demonstrate obvious network connectivity concerns. Although the iPad has the ability to access networks in general, as well as send and receive information, one Soldier stated that "anything that would go down the iPad route is a pipe dream because of the make of the iPad vs. Army security." This was also true for mobile phone as well: "iPhones on the network were not a positive." Thus, networking connectivity considerations are two-fold. One, if the training content necessitates collaboration or networking, it is imperative to ensure that the device has networking capabilities. Two, if the (NEC) does not support the networking use of a certain device (e.g. iPad), the networking connectivity capability of the device itself is a moot point.

Durability. This subfactor concerns the toughness and ability to withstand various physical conditions of various handheld mobile devices in different AIT training contexts. In the survey, participants were asked to consider what is important for decision makers when determining how to integrate digital applications and mobile technologies into AIT. Specifically, participants were asked to identify the importance of the durability of the device/platform being used for the application. 84% of participants responded that the durability of the device/platform being used for the application was either important or very important. 2% of participants responded that the durability of the device/platform being used for the application was slightly important or not at all important.

One instructor stated that mobile devices used in field settings "would need to be durable," as well as "waterproof." Other Soldiers expressed concerns over device durability stating, "Another issue is if we moved to tablets, in the field they may not be durable enough. You'd be dealing with fragile equipment. You'd be facing things being broken. Sticking to a smaller, durable device i.e., an iPhone with a case on it) is probably better. I drop my personal phone and it is usually fine." Thus, it is clear that device durability is an important consideration, especially if the device is intended to be taken into field environments. One Soldier stated that "ruggedness" is an important device consideration because "they [Soldiers] are going to be climbing on stuff, falling off stuff, in the dirt, and in the rain." Also, it seems as if tablets are viewed as less durable than mobile phones; "tablets were more fragile than phones."

Portability. This subfactor concerns the ease of transport of the device. The portability of mobile devices is a characteristic that makes them attractive for training use. When asked what made the mobile devices effective, one training developer responded, "A part was the new wow factor. Students went from carrying books around to carrying this information all in one." Increased portability also means increased opportunity to engage in training and development activities. One indicated that the portability of a mobile device over a laptop was a clear advantage stating, "If a student is motivated, they can use the app during chow time. It allows them more training time." Although some Soldiers stated they would prefer a phone over a tablet when considering portability, other Soldiers disagreed stating that although "tablets [are] a bit too large and cumbersome, I found seven inch tablets worked well in the field, as they fit into cargo pockets." Thus, smaller tablets may be seen as portable as mobile phones. However, it

seems clear that if portability is desired, larger tablets are not afforded the portability of the smaller size mobile phones.

Supportability. This subfactor concerns the ability and resources required to support various handheld mobile devices over time, including the ability to maintain and upgrade devices. Forethought and added consideration should be given to the development of applications and training as the development of technology will continue to outpace the development of applications. When asked how they account for devices becoming outdated, one participant said, "For the basic [development that] we do, we don't have to keep pace with it [the pace of technological advancement]." This comment suggested that less advanced applications, though they will not keep pace with technological capabilities, will still be supported by future devices. A training developer clearly stated that the "goal is to have them consume our products regardless of the device."

Networking, Security, and Implementation Issues

This factor concerns the application used in training, its creation, its use, and its potential value. There were a total of 302 participant comments that focused on this factor. There was one question in the survey related to the application factor. Seven subfactors were identified that helped classify the most important considerations for this factor. Table 12 lists the subfactors and the number of participant responses for each subfactor. Each subfactor is discussed below with supporting evidence extracted from interview and focus group data.

Table 12
Networking and Security Subfactors Comments

Subfactor	Number of Participant Comments
Networking capabilities, restrictions, and policy requirements	36
Device, application, and data security	11
Student restrictions	22
Device management	17

Networking capabilities, restrictions, and policy requirements. This subfactor concerns the networking capabilities, restrictions, and policy requirements associated with connecting and using handheld mobile devices on a network. In the survey, participants were asked to consider what is important for decision makers when determining how to integrate digital applications and mobile technologies into AIT. Specifically, participants were asked to identify the importance of network availability. 66% of participants responded that network availability was either important or very important. 10% of participants responded that network availability was slightly important or not at all important.

The networking capabilities of the mobile devices have previously been discussed and, thus, will not be revisited here. The focus of this section in the decision making process is the networking capabilities of the location (i.e., Army base), where training is to occur. Networking capabilities are important only to the extent that the training content in question necessitates the ability to connect and interact with a network to be effective. As stated by one training

developer, when devices cannot touch the .mil server and are without a service plan/wireless network, "the apps for the devices are great but it is limited in applicability…when you give them [students] no connectivity, it is a joke and they [students] don't use it [the mobile device]." There were issues with NEC and Army networking rules and governance, with one Soldier stating that NEC "was our biggest roadblock" for implementing the use of mobile devices. Specifically, this Soldier stated that approval for the iPhone "took about 6 months." Another Soldier added that "getting around the NEC and their rules" was the biggest barrier to implementing devices in AIT.

Alternatively, in some locations, Soldiers and support staff were permitted to build their own network "to get around security issues" or use internal networks already in place. This ability seems to be of paramount of importance, with one training developer going so far as to say "until WIFI and 3G happens, it is inconvenient to do mobile learning." For instance, when attempting to train Soldiers on a task that typically requires collaboration, if mobile devices are not capable of connecting to a network to allow interaction between Soldiers, the training may not be as realistic, and, thus, effective. One Soldier stated that having interactive ability would have made the training, "more realistic." Thus, it seems important to consider the network capabilities of the installation in question, with a specific focus on network restrictions and policy requirements. Although some areas seem to have solutions to NEC rules and governance, other areas require Soldiers to invest large portions of time to attempt to resolve networking issues. Still, in other locations, the ability to network is not present and unlikely to change, thus removing the possibility of interactivity and collaboration between Soldiers.

However, it is clear that although NEC rules and regulations were seen as a roadblock, Soldiers understood the importance of restrictions, with one Soldier stating, "In our situation, we have a boatload of top secret stuff. We aren't allowed to have WIFI. Someone couldn't steal the information. For our schoolhouse, it's not viable." A training developer added to this by stating, "we need to have a security structure," and there needs to be a "balance between desired usability and network security." Restrictions are also desired to discourage student misuse, with one instructor stating, "If we could use a device that had calls and texts disabled, it would be helpful. It is a temptation for students."

Yet, obtaining this balance seems difficult according to most Soldiers. One instructor stated that "When the students use the tablet, it can be useful. But because of various issues, students don't use them. Data at rest and decrypting are reasons they don't use them." Further, restrictions also impact application development, with one training developer stating that applications with sensitive data hinder the application development process; "Many policies restrict access to what is necessary to develop apps." One training developer proposed forgoing security issues until the end of the development process stating that the solution is to "identify the capability you want then develop the app. Place the app on a device and test it in a small group element, isolated network, or standalone system to allow refinement of the capability according to Soldiers' needs, contracting officer's representative (COR) needs, etc. [Then] ensure you test and validate functionality. Then, start addressing security issues and network requirements…" Thus, it is evident that device related student restrictions are necessary to some degree, but the question becomes, to what extent do restrictions hinder the effectiveness of

training, mobile device use, and application development. These questions should be considered when making decisions related to required and desired student restrictions.

Related to the aforementioned restrictions is the issue of the permanency of these restrictions. If restrictions, such as disabling features of the mobile device (e.g. texting capability), are important, one should consider the permanency of these restrictions. Many Soldiers discussed the lack of permanency of restrictions with certain mobile devices, such as the HTC EVOs and other Android phones. These devices had the ability to "self-heal." Specifically, as one training developer stated, "We could say we don't want these things to work and take the strings out to disable thing and when you turn it off, it self-heals." Thus, the permanency of restrictions placed on a device should be known if restrictions are necessary

Device, application, and security. This subfactor concerns the security capabilities/restrictions of devices and applications. Here, the focus is on the ability to ensure the security of both the device and the application and the ability to circumvent these security measures. Regarding general device and application security points of consideration and issues, most comments dealt with concerns related to the susceptibility of mobile devices and applications to compromises of security. Specifically, what is the consequence of losing a mobile device or losing data from an application? One training developer stated, "I had a Lieutenant come in and say my tablet has been gone a week and a half." Although initial security concerns did arise, the training developer stated they were able to "call our Verizon rep and do our GPS and ping the tablet to remote wipe it and turn it in." Other concerns were related to resourcing application delivery, or "finding an Army solution to the marketplace."

Student restrictions. This subfactor concerns the restrictions or limitations placed on AIT students as part of their training program. Concerns related to restrictions arose from issues regarding the susceptibility of hacking or circumvention and consequences of possible student misuse. Most of the circumvention concerns were related to device capabilities and the permanency of restrictions. As one training developer stated, students "change[d] control numbers; lockout. I couldn't get into the phone without resetting it." Further, although certain functionalities were disabled on the smartphones, one training developer claimed that "you saw innovative Soldiers adapt the phones at night." Other concerns, beyond student circumvention, were expressed regarding leaking of sensitive information, such as a hacker finding out where a Soldier is located via GPS or the compromise of sensitive data "floating through the air." Thus, it seems as the sensitivity of the content as well as the susceptibility of hacking into the content or circumventing device restrictions is an important consideration.

Participants expressed concerns regarding possible student misuse of devices. Soldiers stated that the mobile devices would be a "distractor." Others expressed concern over possible theft and subsequent distribution of mobile devices for profit, with one Soldier concerned that, "you start handing [mobile devices] out to AIT and it winds up in a pawn shop." Other Soldiers offered actual examples of Soldiers breaking "into the closet [and] making phone calls," and circumventing restrictions to "download radios" on the mobile devices. Multiple solutions were provided for these issues such as not issuing the mobile devices "below E-6s in charge of the AIT students," instilling a sense of responsibility into the Soldiers who are given a mobile device, or developing an "app counter to tell how many times an app has been used." These

comments suggest that student misuse is a possibility and introducing mobile devices to Soldiers should consider these possible outcomes.

Device management. This subfactor concerns the management of devices (e.g., how devices should be distributed, locked/secured, stored, repaired/maintained). The central concepts that participants discussed concerning device management were accountability and responsibility. One training developer who had been responsible for administering the devices in a pilot said, "When I talk to Verizon they give me a spreadsheet to watch them. I turn it into a spreadsheet first name last name and their outfit. They sign for the cost. The agreements they are signing for them. If it were up to me their S4 would sign for them. But as a pilot program, we are keeping track of everything so we have the accountability. I'll track the master list of this many went to so–and-so and then it is their job. It is a transfer of equipment."

There were mixed opinions as to who should have the responsibility for devices. One training developer suggested that devices could be assigned to each unit: "They could have the devices but assigned to the unit so they check them out as needed. A group could have one. Even if for each individual they would sign them out as needed. Then the units would keep them under lock and key and charged. They'd say Thursday we are going to use them and have them ready." One training developer warned against taking time away from leaders or instructors by making them responsible for devices: "Checking mobile devices takes more time away from drill sergeants. Plus Soldiers will still break in and take the phones." Another training developer recalled a time that responsibility for devices was given to a leader and there was a problem with misuse: "The kids broke into the closet making phone calls to boyfriend, mom. They were kept in the barracks and that was the only time that we signed things over to the S4. They saw where he kept them. It was a one-time incident. If you keep the weapons in a security locker, why weren't the EVOs."

Device and Application Value

This factor concerns the value associated with implementing digital applications and mobile learning. There were a total of 56 participant comments for the *Device and Application Value* factor. There was one questions in the survey related to the device and application value factor. Three subfactors were identified that helped classify the most important considerations for this factor. Table 5 displays the subfactors and the number of participant responses for each subfactor. Each subfactor is discussed below with supporting evidence extracted from interview and focus group data.

Table 13
Device and Application Value Subfactors Comments

Subfactor	Number of Participant Comments
Supplement in-class training content	37
Self-development training content	8
Demonstration, assessment, testing	8

In the survey, participants were asked to consider what is important for decision makers when determining how to integrate digital applications and mobile technologies into AIT. Specifically, participants were asked to identify the importance of the mix of instructor led, self-directed, and distributed learning. 92.2% of participants responded that the mix of instructor led, self-directed, and distributed learning was either important or very important. 4% of participants responded that the mix of instructor led, self-directed, and distributed learning was slightly important or not at all important.

Supplement in-class training content. This subfactor concerns the use of handheld mobile devices to supplement training and the program of instruction for a course. A vast majority of participants believed that mobile learning is best used to supplement training in AIT. One participant said that mobile learning "needs to be blended." A training developer said, "Instructors must integrate apps/devices into instruction and reorganize how they teach to incorporate the app." One student cautioned that students should be able to use mobile devices as aids but must not become reliant on them to do their job: "If they rely on that to learn how to do it and then get out to the range and can't do it without the tablet. For common tasks that you need to know by heart you are developing a crutch."

Participants provided several examples to describe how mobile learning can supplement AIT. Most of the examples discussed the effectiveness of mobile devices in early training or as practice. One student said, "Using it in the crawl phase of crawl-walk-run would be extremely useful in shortening the time spent in the crawl phase." A training developer said, "We used materials for blended learning to go along with instruction. Training aids for the Soldiers. It helps them to get that up front. It's not intended to delete the instructor led training." Multiple participants described how students could use devices to practice. One participant said, "Allowing them to practice without the use of the equipment. We don't have enough equipment or instructors, but we have enough computers." A student said, "If you can practice on a device a lot before you get on the actual equipment, and you've ran through it, you are going to perform a lot better with the equipment. When I used the equipment for the first time, I already had a good idea of what to do."

As part of supplementing training, participants described the value of having mobile devices as a quick reference. One training developer said that it was useful to have mobile devices as "references for the manuals, if we don't have printed copies." One training developer described how a student would use it as a reference: "If my instructor is telling me to do this you forget the steps, well then you can look back real quick to a reference. If they can go back and look, not during a test, but on a task, to look at checklists, not necessarily homework, but if they are in the field and told to change a part out and they don't remember all the steps they can bring the app up and it will tell them the order and complete the task without going back to the instructor." Additionally, it was suggested that links to doctrine would help teach doctrine during training: "Having Army Regulations (ARs) so people can look them up would be nice. You can look them up on a computer. We don't have a lot of time/access to that information. I can try to look it up on my phone, but if the regulations were easily available, you are thinking of something, you would get more of an AR understanding and knowledge of what is actually said. People will be able to recall that faster."

Replace training content. There were several reservations about to what extent mobile applications can be used to replace training. One training developer said, "A whole course shouldn't be an application." One instructor said, "You can't beat equipment hands-on training. You can't replace hands-on equipment with an app. There is a difference between tightening a screw with a screw driver and pressing a button that simulates a screw going in. Hands-on training is where it cannot be replaced." However, previous hard copy training aids that had been used to supplement training can be delivered via mobile devices. One training developer said there was "lots of call for hip-pocket training and aids. Mobile apps can replace them."

Self-development training content. This subfactor concerns the use of handheld mobile devices to be used for self-development training. Self-development training is training initiated and motivated by the individual taking the training. Several participants suggested that the mobile devices would be useful for delivering self-development training. One training developer said, "Our culture is a lot more motivated these days to learn on their own. They do a lot more research. It's all just expected." Another training developer said that when the curriculum was put on iPods, "Soldiers began 'playing' the interactive portions on their own." One training developer described how self-development took place when using mobile devices: "With mobile learning there is the intent and how they ended up using it. Because of this and that they were collaborating after hours. Given tools that Soldiers already know how to use they will use them to their full capabilities. It is the conversation that is going on in the hallway. It is ongoing learning and that is mobile learning."

Participants suggested that mobile devices were effective for self-directed learning and a valuable part of training during down time. Participants suggested that Soldiers are ready for Self-Directed Learning. The devices were seen as a means to encourage self-directed learning. One participant said, "I think it has had a positive effect on the students. Before, we'd see a lot of the students lolly-gagging around during down time. Now, they are using the devices and want to learn instead of sitting around and doing nothing."

Demonstration, assessment, and testing. This subfactor concerns the development of applications as a method for demonstrating (e.g., crew drills), assessing (e.g., knowledge checks), or testing (e.g., using handheld mobile devices to test student training content knowledge or skill) during learning. Several participants identified the value of having mobile devices to be used for assessment or as a check on learning. One student described a way that assessments might be used: "The most benefit outside of FMs, the best would be at home in place of instructor. If we had something that we could use as a test, then you don't have to wait for an instructor you can address common issues. Even if it is going through medical tasks, but just evaluate and choose yes/no it will not teach you but it will prep you for the next day." One training developer suggested that tests be coupled with entertainments games: "Multiple choice tests, if you get five correct in a row you get to play the game."

Device and Application Costs

This factor concerns the application used in training, its creation, its use, and the potential value gained by utilizing the application. There were a total of 24 participant comments regarding this factor. There were no questions in the survey related to the *Device and*

Application Costs factor. Two subfactors were identified that helped classify the most important considerations for this factor. Table 14 lists the subfactors and the number of participant responses for each subfactor. Each subfactor is discussed below with supporting evidence extracted from interview and focus group data.

Table 14
Device and Application Costs Subfactors Comments

Subfactor	Number of Participant Comments
Device costs	17
Application development costs	5
Device/Application maintenance costs	5

Device costs. This subfactor concerns the costs associated with purchasing a device and device accessories (including Device Peripherals such as projectors, ruggedized cases, styluses, etc.). Several participants described costs associated with devices. These concerns were focused on the initial cost of the device, responsibility for the device, and fear of costs associated with breaking the device. First, the participants realized that the initial cost for purchasing devices would be a substantial investment. Furthermore, devices may not be cost efficient for effectively training every MOS. One commander said, "It is expensive. There is a contract the Army has to sign…it is expensive but for [our MOS], because our graduation rate is already high, it is hard to argue that we need the app and mobile devices and that it is doing some dramatic change. Even though I think it is good, it will be hard to prove that it is worth it."

Participants discussed the responsibility of having mobile devices. One instructor felt that AIT students would not be ready for the responsibility: "At the Platoon Sergeant level that could work, but not the actual students. No students, out of fiscal responsibility. You start handing out to AIT and it winds up at a pawn shop. Security and fiscal responsibility would keep from issuing at that level." Also, students themselves mentioned that there was a fear of being responsible for the devices: "Initially my class did not want them because they were afraid of losing, damaging the devices and being responsible for paying for them. A lot of them weren't happy with that because they are not cheap. After they did stuff with them they warmed up to them but they weren't comfortable if they lost them."

Many participants discussed the cost associated with breaking the device. Participants suggested that some field training environments would be inappropriate for devices because of the potential for breaking the device. One instructor said, "In my AIT it would get broken unless you are dealing with mine detection. For combat engineer it would be too many buttons." For many participants, durability of the devices was an issue and was also related to a fear of having to replace devices. However, a pilot test administrator described the actual status of the mobile devices following a mobile learning pilot: "Out of 248 [smartphones] that we lent AIT for a pilot [test], I had 2 with water damage, 9 total problems, 1 internally fried, 6 screens broken. They were still under warranty." Perhaps warranty or phone insurance against damage could be used to minimize the fear of associated costs due to damage.

Application development costs. This subfactor concerns the costs associated with developing training applications to be used on handheld mobile devices. The development of training applications for mobile devices can be costly. Training developers, technical experts, and developer licenses represent the main application development costs. One training developer noted that "[the contracting process [is] not ideal for app development" and that it is "easier to overcome with government workers." Another training developer suggested that "[the] cost is offset by printing. Everything in the Army library is pdf."

Device/application maintenance costs. This subfactor concerns the costs associated with maintaining and upgrading devices and applications. Examples of maintenance and upgrades include, but are not limited to, simple device repair (e.g., damaged screen), device operating system (OS) upgrades, application bug removal, and application upgrades intended to reflect changes in training content. Most of the comments related to this subfactor focused on the need to conduct maintenance on applications and upgrading applications. One training developer suggested, "There needs to be a feedback mechanism for users to provide feedback [to developers]." This type of a mechanism would allow for users and instructors to identify changes that could improve applications. It was evident that changes and upgrades to applications need to factor in how long it will take to make corrections and related costs.

Additional subfactors. Through analysis of the data and comparing the results to the findings from the literature review, the research team generated additional subfactors that were not specifically identified by data collection participants. These subfactors are based on psychological research or instructional design practices:

- Feedback requirements: providing students feedback during training
- Level of fidelity of training: the realism of training compared to the practical environment
- Aided or unaided training: the extent to which training is aided by an instructor
- Inherent training risks and consequences of performance: the extent to which physical danger is associated with the training
- Need for peripherals: the extent to which peripherals are needed for use with handheld devices for training
- Reusability: the aspects of mobile learning that are reusable
- Network costs: costs associated with establishing a network to use with handheld devices.

Discussion

Building on the literature review, the quantitative and qualitative results presented a comprehensive list of the factors and subfactors most in need of consideration to effectively design and implement digital applications using handheld mobile devices in AIT. As described in the results section, the factors and subfactors provided a practical organization representing the issues and solutions that decision makers would need to design and implement digital applications using handheld mobile devices in AIT. The research team used the data collection results and the lessons learned in the literature review to create a decision guide.

The data collection produced 10 factors and 35 subfactors. These factors and subfactors were included in the design of the decision guide. Using the quotes, data, and literature review, the research team created issues and potential solutions to those issues to help decision makers design and implement mobile learning. In addition to the 35 subfactors, 7 more subfactors were added to the decision guide. Some of these subfactors lacked a sufficient amount of support to single out in the results, but anecdotal support from interviews and focus groups combined with lessons learned from the literature review was sufficient enough to identify issues and solutions that needed to be included in the guide. The other subfactors that were added to the guide, but not described in the results section were added because the information learned in the results section led to research team insight that needed to be included in the decision guide. Table 15 reviews the subfactors that were added to the Decision Guide, but were not described in the results section.

Table 15
Decision Guide Subfactors not Included in the Results Section

Factor	Subfactor	Description
Training Content	Feedback requirements	Concerns the need to provide students feedback during training.
Training Content	Level of fidelity of training/assessment environment	Concerns the level of fidelity associated with the training environment compared to the execution of learned tasks in the practical environment.
Training Content	Aided/Unaided	Concerns whether training is aided or unaided. Specifically, is training delivery accompanied with instructor assistance, or do students complete training without the assistance of an instructor?
Training Content	Inherent training risks and consequences of performance	Concerns whether there is any physical danger or risk associated with training and the consequences of committing an error in training.
Device	Need for peripherals	Concerns the need to have additional peripherals (e.g., projector) to be used in conjunction with the devices to deliver training.
Device and Application Value	Reusability	Concerns what aspects of mobile learning are reusable.
Device and Application Costs	Network costs	Concerns the costs associated with using or establishing a network for use with the handheld mobile devices.

Following the analysis, the research team created a means for organizing the factors. These meta-factors were used in the decision guide to better organize information for decision makers and provide further understanding as to how the factors are related. The three factors

were training methods and delivery, human and contextual factors, and hardware and infrastructure capabilities and constraints. Table 16 lists the meta-factors and identifies which factors belong to each meta-factor.

Table 16
Metafactors and Related Factors

Metafactor	Factor
Training methods and delivery	Application
Training methods and delivery	Training Context
Training methods and delivery	Training Content
Human and contextual factors	Students
Human and contextual factors	Instructors
Human and contextual factors	Institutional Support
Hardware and infrastructure capabilities and constraints	Device
Hardware and infrastructure capabilities and constraints	Networking, Security, and Implementation

The purpose of the guide was to assist in identifying important information regarding how student, course, instruction, and learning environment issues affect decisions of where, when, and how to integrate digital applications and mobile technologies within AIT courses. This guide was designed to aid those who have decided that they want to employ handheld mobile devices and learning applications in their training programs. While the issues and suggestions reviewed could be of some use in initially considering these technologies as a potential training option, the decision to implement handheld mobile devices and programs was left to individual commanders and other key decision makers with full knowledge of their available resources, funding, and unique training requirements and environments. Therefore, the guide assumed that the decision to explore employing mobile learning technologies has largely been made.

The target audience for the guide included anyone interested in developing and integrating digital applications and/or handheld mobile technologies to support training, including but not limited to:

1. AIT Battalion Commanders
2. AIT Battery and Company Commanders
3. Training and course managers
4. Instructors, training developers, and instructional designers

The guide was structured to aid the identification of key issues and potential solutions related to implementing handheld mobile technologies and digital applications into existing or proposed training courses. The guide was also structured to provide a logical, deliberate process and checklists for the user to critically examine recommendations provided from published research and to determine whether these issues and potential solutions apply to their specific training context. This information was organized into a series of meta-factors, factors, and subfactors levels related to key training, device, and application constructs.

The guide was organized into two sections. The two sections were designed to provide different levels of detail, allowing users the ability to consider more general descriptions of issues and solutions at a factor level and then delve into more detail for each of the factors at the subfactor level. Section intended to give a broad, upper level overview of information and issues to consider when implementing handheld mobile devices and digital applications that could also be used as an initial critical consideration of key issues. Section 2 provided a more detailed examination at the more specific subfactor level, which provided significantly more information related to the impact of the subfactors on the decision to implement a handheld mobile technology or digital application into an existing or proposed course.

Following the creation of the draft decision guide, several participants from the data collection were contacted to review the guide and provide input on the factors, recommendations, and guidelines put forth in the guide. The final decision guide was structured to provide not only a framework for making decisions regarding the use of handheld devices in AIT, but also provides information to educate users of the guide on issues that may need to be considered.

Limitations

There were limitations that had an effect on this research and the design of the decision guide. First, at the time of this research, the Army's view of the use of handheld devices in training was still evolving and there was no official policy regarding the use of such devices in training. Second, and related to the novelty of handheld devices being used in Army training, there were a limited number of SMEs from whom to collect data. There simply were not many individuals with experience designing or implementing training with handheld devices. Third, research concerning the use of mobile learning devices for training and educational purposes was in its infancy at the time of this research. Outcomes on training (e.g., less training time required, greater retention of information, etc.) have not been empirically evaluated yet.

All of these limitations resulted in the decision guide being more preliminary in nature than a traditional decision guide. For example, the decision guide includes descriptions of each factor and subfactor, potential issues that may be encountered and possible solutions rather than being structured strictly as a decision tree. This level of detail was intended to help inform an audience for whom much of this information would be new and to therefore increase usability and value of the guide.

Future Use and Dissemination

The decision guide was developed with an orientation towards providing AIT commanders and decision makers a useful tool to help guide their implementation of mobile devices into AIT. Some concerns expressed by participants during this project indicated that the AIT trainee population may present unique concerns in utilizing mobile devices in AIT. For example, most AIT Soldiers are quite young, and while they have more independence in AIT that they had in basic training, there are still concerns about allowing AIT Soldiers freedom with these devices in their barracks. These concerns stem from a mistrust of AIT Soldiers taking care of these devices, managing their time appropriately, using the devices for official purposes only,

and not meddling with the settings and restrictions placed on them by the trainers and technology support staff. However, aside from these issues, there were few concerns or lessons learned that were uniquely limited to an AIT environment. Many of the concerns would be appropriate for other Army training environments. As such, this guide could easily be useful for commanders of other training organizations and other decision makers considering how best to implement mobile devices to help achieve their training goals.

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ACRONYMS

2LT	2nd Lieutenant
ADDIE	Analysis, Design, Development, Implementation, and Evaluation
AIT	Advanced Individual Training
ALM	US Army Learning Model
AR	Army Regulation
ARCIC	US Army Capabilities Integration Center
ARI	Army Research Institute
BLSS	Blended Learning Satisfaction Scale
BOLC	Basic Officer Leaders Course
CAC	Combined Arms Center
CAC	Common Access Card
CASS	Case analysis attitude scale
CoEs	Centers of Excellence
COR	Contracting Officer's Representative
CPT	Captain
CSDA	Connecting Soldiers to Digital Applications
DCG-IMT	Deputy Commanding General for Initial Military Training
DTIC	Defense Technical Information Center
FAQ	Frequently Asked Questions
FM	Field Manual
GPS	Global positioning system
GS	General Schedule (US Civil Service)
IET	Initial Entry Training
iOS	iPhone Operating System
IMI	Interactive Multimedia Instruction
ITE	Integrated Training Environment
LTC	Lieutenant Colonel
MAJ	Major
MDMP	Military Decision Making Process
MOS	Military Occupational Specialty
MS	Metacognition scale
NCO	NonCommissioned Officer
NEC	Network Enterprise Center

OE	Operational Environment
PBL	Problem-Based Learning
PDF	Adobe Portable Document Format file
PFC	Private First Class
POI	Program of Instruction
PPT	Powerpoint
PV2	Private 2
RFID	Radio Frequency Identification
SBL	Studio-based Learning
SCoE	Sustainment Center of Excellence
SDL	Self-Directed Learning
SFC	Sergeant First Class
SMART	Specific, Measurable, Achievable, Realistic, and Time-based
SME	Subject Matter Expert/Expertise
SRL	Self-Regulated Learning
SSG	Staff Sergeant
TADSS	Training Aids, Devices, Simulators, and Simulations
TM	Training Manual
TRADOC	U.S. Army Training and Doctrine Command

Appendix A: Data Collection Protocol

Mobile Learning Protocol
(2/20/2012)

Introduction & Research Purpose

Good morning/good afternoon and thank you for taking the time to participate in this (focus group/interview). My name is (*Facilitator*) and these are my colleagues, (*Recorder*), (*ARI*). (*Recorder*) and I work for a company called ICF International and (*ARI*) is from the US Army Research Institute. We are all part of a research team that the US Army Research Institute (ARI) has put together to develop a practical decision guide for key decision makers to use in determining the utility of digital applications and mobile technologies for AIT and to develop metrics for assessing their impact on training. As part of this endeavor, we are interviewing subject matter experts (SMEs), such as yourself, who have participated in the Connecting Soldiers to Digital Applications (CSDA) pilot tests or have past experience in this area. Our goal is to identify lessons learned, best practices, and critical decision making keys for incorporating this technology into AIT.

The (interview/focus group) session will take (60/90) minutes to complete.

Privacy Act Statement & Consent Form

Please note that your participation is voluntary – there are no consequences if you choose not to participate. Everything you say will remain confidential. We will be transcribing your responses on a laptop, but our analysis and reporting of your responses will be at the group or aggregate level—not at the individual level. No single individual's comments will be referenced in any report or presentation in a manner that could potentially identify the specific source, so please be as candid as possible in your responses to our questions.

To more fully explain the confidentiality process and how we will be using the information you provide today, I have a privacy statement and consent form for you to read over. Please take a few minutes to read over both documents. If you choose to participate, please sign the second page of the consent form and indicate that you are over 18 years old and are voluntarily agreeing to participate (*Have them sign the digital recorder block as well if applicable)* Please let me know if you have any questions about the privacy statement, consent form, or the session today. If you are not 18 yrs of age or choose not to participate, please return your forms to me and return to your normal duties. *(Wait, until it looks as though everyone has signed the forms and then ask for the signed page of the consent forms).* Once you have signed your form, please return the signed page to me. You may keep the remainder of the document and the summary provided by the privacy act statement for your records and later reference.

(Focus Groups only)

Since your comments and suggestions are critical to this research, we are asking all of you to maintain the group's confidentiality. Can we all agree that what is said in this room stays in this room?

To make our discussion go smoothly, let's lay out some ground rules:

- Please speak clearly and one at a time
- Please avoid sidebar conversations
- There are no right or wrong answers
- We want to hear the good and the bad
- Any and all differences of opinion should be respected and valued

Do you have any questions for me at this time either in terms of the content of our conversation or this research effort? (*Answer any questions that may arise*).

Background Worksheet & Questionnaire

Before we begin our discussion, we have a background worksheet and a brief questionnaire for you to fill out.

Background Worksheet

(Please print all responses clearly)

1. Rank: _____

2. Position (circle one):

   Student Instructor Training Developer CDR 1SG

   Other (please identify): _____

3. Have you been involved in any effort to use digital applications and mobile technology during training? Yes / No (Circle one). If "Yes", briefly describe the effort and how you were involved.

_____

_____

_____

_____

_____

Supplement Worksheet

(Only for those consenting individuals <u>unable to</u> participate in the interview/focus group session)

1. What previous experience have you had with integrating digital applications and mobile technologies into training? (*Mark all that apply*).

   ☐ Evaluated the effectiveness of digital applications and / or mobile technologies for training

   ☐ Developed digital applications and / or mobile technologies for training purposes

   ☐ Used digital applications and / or mobile technologies when conducting training

   ☐ Been a student in a class or received training where digital applications and / or mobile technologies were used

   ☐ Conducted classes on how to design, develop, and/or maintain digital apps for military settings

   ☐ OTHER (please describe in the space below any additional experiences (not listed above) you have had with digital applications and mobile technologies in training settings):

_____

_____

_____

2. Briefly identify (in bullet form; label as indicated) any lessons learned (LL), or recommendations (R) that would be helpful when making the decision to integrate digital applications and mobile technologies into AIT training. For example, you could identify:

   What were some of the factors that made using digital applications and mobile technologies in AIT effective?

   What were some of the roadblock or obstacles you encounter when using digital applications and mobile technologies in AIT?

What methods or techniques did you use to overcome roadblocks or obstacles encountered when using digital applications and mobile technologies in AIT?

Mobile Learning Questionnaire

1. Current publications have identified a number of instructional practices commonly associated with using digital applications and mobile technologies in training environments. Please rate your experience to date using digital applications and mobile technologies with the identified instructional practices. Please use the following scale to rate your level of experience for each identified practice:

Experience Scale

1 - I have experience using digital application and mobile technologies with this instructional practice.

2 - I have experience with this instructional practice, but no specific experience using digital applications and mobile technologies in combination with this instructional practice.

3 - I have very little or no experience using this instructional practice either alone or in conjunction with mobile devices/technologies

INSTRUCTIONS: Please select the response that best reflects your experience with using digital applications/mobile technologies with the instructional practice identified below.

Instructional Practice	Experience Rating
1. **Encouraging Self-Directed Learning -** Encouraging students to address their own learning needs outside of directed course or training requirements. **Example:** Providing an online forum for students to share developmental resources for their own self-development.	1 2 3
2. **Using Goal Setting -** Having students identify performance or learning goals and plan for achieving them. **Example:** Using a skill-based goal setting application to develop learning goals and monitor progress towards achieving them.	1 2 3
3. **Using Problem or Scenario Based Learning -** Training through the use of complex, scenario based problems. **Example:** Requiring students to solve an equipment malfunction problem that can be examined and tested using apps on a smart phone.	1 2 3
4. **Using Scaffolding or Instructor Support -** Instructors, peers, or others providing support and structure that allows students to reach higher/new levels of understanding learning. **Example:** Using smartphones apps to provide learning hints and feedback based on specific student responses/performance	1 2 3
5. **Using Experiential Learning -** Encouraging students to learn through their own direct experiences to develop required skills and knowledge. **Example:** Requiring students to work through a training app that requires them to review the basic operation and functions of a piece of equipment before seeing it in the classroom.	1 2 3
6. **Using Collaborative and Cooperative Learning-** Encouraging students to work with other students to accomplish shared goals. **Example:** Having students participate in an online student forum in which teams solve problems.	1 2 3
7. **Using Situational Learning-** Delivering training within the same or very similar context in which it is expected to be applied. **Example:** Providing a 3-dimensional representation of equipment on a smart phone that can be consulted when training day-to-day equipment use.	1 2 3

2. **INSTRUCTIONS:** On the following page, for each instructional practice identified please indicate if, based on your experiences, you believe using digital applications and mobile technologies will have a **positive, a negative or no effect** on each of the listed training outcomes in an AIT environment . Please use the impact scale provided below to rate the impact on each outcome. If you do not have an opinion or have no experience with the described instructional practice, please indicate **N/O** (No Opinion). Provide a rating for each instructional practice as it relates to each of the training outcomes.

Impact Scale

1 = Positive Impact
2 = No Impact
3 = Negative Impact

N/O = No Opinion.

One way of completing these ratings is to ask yourself:

"At AIT, the use of digital applications and mobile technologies with **(*insert Instructional Practice)*** will have a **(*insert impact rating*)** on **(*insert training outcome*)."**

For **EXAMPLE,** one's completed ratings for "Encouraging Self-directed Learning" might look like the following:

INSTRUCTIONAL PRACTICES *(using digital applications and mobile technologies)*	Increase student motivation to learn	Increase retention of learned skills and knowledge throughout AIT	Enhance Student performance (meeting or exceeding standards)	Increase transfer of knowledge and skills to operational contexts	Make training more efficient (reducing time spent or costs of training)
1. **Encouraging Self-Directed Learning -** Encouraging students to address their own learning needs outside of directed course or training requirements. **Example:** Providing an online forum for students to share developmental resources for their own self-development.	2	3	1	N/O	2

Remember to use the following method of thinking when rating the impact of using digital applications and mobile technologies (with each instructional practices) on each of the different training outcomes: **"**At AIT, the use of digital applications and mobile technologies with **(*insert Instructional Practice)*** will have a **(*insert impact rating*)** on **(*insert training outcome*).**"	**Scale:** **1=Positive Effect** **2=No Effect** **3= Negative Effect** **N/O = No opinion**

INSTRUCTIONAL PRACTICES *(using digital applications and mobile technologies)*	**TRAINING OUTCOMES**				
	Increase student motivation to learn	Increase retention of learned skills and knowledge throughout AIT	Enhance Student performance (meeting or exceeding standards)	Increase transfer of knowledge and skills to operational contexts	Make training more efficient (reducing time spent or costs of training)
1. **Encouraging Self-Directed Learning -** Encouraging students to address their own learning needs outside of directed course or training requirements. **Example:** Providing an online forum for students to share developmental resources for their own self-development.					
2. **Using Goal Setting -** Having students identify performance or learning goals and plan for achieving them. **Example:** Using a skill-based goal setting application to develop learning goals and monitor progress towards achieving them.					
3. **Using Problem or Scenario Based Learning -** Training through the use of complex, scenario based problems. **Example:** Requiring students to solve an equipment malfunction problem that can be examined and tested using apps on a smart phone.					
4. Using Scaffolding or Instructor Support - Instructors, peers, or others providing support and structure that allows students to reach higher/new levels of understanding learning. **Example:** Using smartphones apps to provide learning hints and feedback based on specific student responses/performance					

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INSTRUCTIONAL PRACTICES *(using digital applications and mobile technologies)*	**TRAINING OUTCOMES**				
	Increase student motivation to learn	Increase retention of learned skills and knowledge throughout AIT	Enhance Student performance (meeting or exceeding standards)	Increase transfer of knowledge and skills to operational contexts	Make training more efficient (reducing time spent or costs of training)
5. **Using Experiential Learning -** Encouraging students to learn through their own direct experiences to develop required skills and knowledge. **Example:** Requiring students to work through a training app that requires them to review the basic operation and functions of a piece of equipment before seeing it in the classroom.					
6. **Using Collaborative and Cooperative Learning-** Encouraging students to work with other students to accomplish shared goals. **Example:** Having students participate in an online student forum in which teams solve problems.					
7. **Using Situational Learning-** Delivering training within the same or very similar context in which it is expected to be applied. **Example:** Providing a 3-dimensional representation of equipment on a smart phone that can be consulted when training day-to-day equipment use.					
8. Other learning strategy: _____ _____ _____					

3. Based on your experiences using or working with digital applications and mobile technologies **during AIT**, identify how effective you think they were in each of the following training environments? (*Mark only one box per row).*

	EFFECTIVENESS					
TRAINING ENVIRONMENT	Very Ineffective	Ineffective	Neither Effective nor Ineffective	Effective	Very Effective	No Opinion
Classroom Instruction in AIT	☐	☐	☐	☐	☐	☐
Field Instruction in AIT (e.g., hands on training on identified tasks)	☐	☐	☐	☐	☐	☐
Concurrent Training (e.g. reviewing first aid while waiting for other Soldiers to complete their firing iteration)	☐	☐	☐	☐	☐	☐
Informal Instruction (e.g., reviewing course content in the barracks)	☐	☐	☐	☐	☐	☐

4. How important are the following factors to consider for decision makers when determining how to integrate digital applications and mobile technologies into AIT?

AREAS OF CONSIDERATION	IMPORTANCE					
	Not at all Important	Slightly Important	Somewhat Important	Important	Very Important	No Opinion
Training Environment						
The objectives of the training (e.g., training objectives versus learning objectives)	☐	☐	☐	☐	☐	☐
The knowledge, skill, and psychomotor requirements of the MOS being trained	☐	☐	☐	☐	☐	☐
The background and qualifications of the instructor conducting the training	☐	☐	☐	☐	☐	☐
The mix of instructor led, self-directed, and distributed learning	☐	☐	☐	☐	☐	☐
The nature of the learning opportunities and what the focal intent of the training is on (e.g., knowledge, skill acquisition, practice and feedback)	☐	☐	☐	☐	☐	☐
The requirements of the specific task being trained (e.g., some tasks may require the use of a student's hands making it difficult to hold the device and perform the task)	☐	☐	☐	☐	☐	☐
The availability of training resources, especially operational equipment, ranges, and simulators	☐	☐	☐	☐	☐	☐
The amount of time available for each training area	☐	☐	☐	☐	☐	☐
Leadership support for implementing mobile devices for training	☐	☐	☐	☐	☐	☐
Users						
The instructor's knowledge of mobile device capabilities	☐	☐	☐	☐	☐	☐
The instructor's ability to use mobile devices along with instructional practices	☐	☐	☐	☐	☐	☐

(Continue onto next page)

AREAS OF CONSIDERATION	IMPORTANCE					
	Not at all Important	Slightly Important	Somewhat Important	Important	Very Important	No Opinion
The student's background and experience	☐	☐	☐	☐	☐	☐
The student's level of motivation and learning orientation	☐	☐	☐	☐	☐	☐
The role of other persons in training (e.g., peers)	☐	☐	☐	☐	☐	☐
The maturity level of students	☐	☐	☐	☐	☐	☐
The ability for cadre/instructors to control certain features of the device	☐	☐	☐	☐	☐	☐
Device						
Device capabilities such as memory, input/output, capabilities, connectivity	☐	☐	☐	☐	☐	☐
Usability of the device/application (e.g., user friendliness, screen size, ease to program/set-up, etc.)	☐	☐	☐	☐	☐	☐
Utility of the device/application (i.e., **how effective** is the device/application for doing what you want it to do?)	☐	☐	☐	☐	☐	☐
Durability of the device/platform being used for the application	☐	☐	☐	☐	☐	☐
Network availability	☐	☐	☐	☐	☐	☐
The type of device (e.g., tablet versus smart phone)	☐	☐	☐	☐	☐	☐
Add any additional considerations below and rate the criticality of each						
	☐	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐	☐

Focus Group/Interview Questions

Instructions: Interviewers / Facilitators should only ask the **optional question** below when they have determined that participants have not provided enough information on question 3 of the background worksheet. Otherwise, they should start with question 1. Also, Interviewers / Facilitators need to be cognizant of the time available for focus group / interview questions after participants have completed the questionnaire. If time is limited, questions in **bold** get priority over the bulleted prompt questions. Prompt questions should only be used when time permits and then only after asking a bolded question when the interviewer / facilitator feels more detail regarding that topic is required.

EEA1: How can mobile devices be used in AIT to add value to training?

Optional Question: What experiences have you had with digital applications and mobile technologies in your AIT program?

1. **In your experience, what are some of the factors that have made using digital applications and mobile technologies in AIT effective? Why were they effective?**

   In your experience, what are the primary roadblocks to consider when integrating digital applications and mobile technologies in AIT? How were they overcome (e.g., work around)?

EEA2: Training Environment

2. **What types of tasks or training objectives would be most appropriate for training with digital applications and mobile technologies? Why?**

   What types of tasks would not be appropriate for training with digital applications and/or mobile technologies? Why? What distinguishes them from other types of tasks?

   What types of presentation formats (e.g., lecture, audio, video, games, simulation) have been most effective at delivering training in your AIT using digital applications and / or mobile technologies? Why?

   What types of presentation formats are not well suited for digital applications and mobile technologies? Why?

EEA3: User Considerations

3. **What is the best way to ensure instructors buy into the use of digital applications and mobile technologies in their training?**

   What is the best way to ensure others involved in the training (e.g., AIT commander, AIT Platoon Sergeant) buy into the integration of digital applications and mobile technologies?

How would student characteristics affect the success of integrating digital applications and mobile technologies into training?

EEA4: Device Considerations

4. **Which is the most important device consideration when integrating digital application and mobile technologies into AIT training: usability, utility or capability? Why?**

   What considerations should be made regarding usability in the decision to integrate digital applications and mobile technologies into training and why? Examples of usability include things like user friendliness, durability, screen size, etc.

   What device capabilities are /should be considered in the decision to integrate digital applications and mobile technologies into training and why? Examples of capabilities include bandwidth, reception, battery life, and audio/video resolution.

   What considerations should be made regarding utility in the decision to integrate digital applications and mobile technologies into training and why? The utility of a device refers to *how effective* is the device/application for doing what you want it to do?

Concluding Comments

5. **Finally, regarding our goal to develop a decision guide for implementing mobile devices into AIT. Are there any additional factors, lessons learned or guidance that you would like to share regarding what we've been talking about?**

Thank you again for your time and participation. Your comments have been very helpful. Before we let you go, we were wondering if you would be willing to assist us with reviewing the near final version of the decision guide once it has been developed. This would probably occur _____ *(If yes, get their email address).*

Appendix B: Quantitative Results – Effect of Using Mobile Applications with Instructional Practices

The effect of using digtial applications and mobile technologies with	Increase student motivation to learn					
	Positive Impact		No Impact		Negative Impact	
	Count	Row N %	Count	Row N %	Count	Row N %
Encouraging Self Directed Learning effect on	34	73.9%	9	19.6%	3	6.5%
Using Goal Setting effect on	34	77.3%	8	18.2%	2	4.5%
Using Problem or Scenario Based Learning effect on	35	76.1%	11	23.9%	0	0.0%
Using Scaffolding or Instructor Support effect on	32	68.1%	13	27.7%	2	4.3%
Using Experiential learning effect on	35	74.5%	11	23.4%	1	2.1%
Using Collaborative and Cooperative Learning effect on	29	64.4%	14	31.1%	2	4.4%
Using Situational Learning effect on	39	84.8%	7	15.2%	0	0.0%
Other Learning Strategy effect on	2	100.0%	0	0.0%	0	0.0%

The effect of using digtial applications and mobile technologies with	Increase retention of learned skills and knowledge throughout AIT					
	Positive Impact		No Impact		Negative Impact	
	Count	Row N %	Count	Row N %	Count	Row N %
Encouraging Self Directed Learning effect on	35	79.5%	9	20.5%	0	0.0%
Using Goal Setting effect on	29	65.9%	15	34.1%	0	0.0%
Using Problem or Scenario Based Learning effect on	39	83.0%	8	17.0%	0	0.0%
Using Scaffolding or Instructor Support effect on	33	73.3%	10	22.2%	2	4.4%
Using Experiential learning effect on	42	89.4%	5	10.6%	0	0.0%
Using Collaborative and Cooperative Learning effect on	27	61.4%	16	36.4%	1	2.3%
Using Situational Learning effect on	42	91.3%	3	6.5%	1	2.2%
Other Learning Strategy effect on	2	100.0%	0	0.0%	0	0.0%

The effect of using digtial applications and mobile technologies with	Enhance Student performance (meeting or exceeding standards)					
	Positive Impact		No Impact		Negative Impact	
	Count	Row N %	Count	Row N %	Count	Row N %
Encouraging Self Directed Learning effect on	33	73.3%	11	24.4%	1	2.2%
Using Goal Setting effect on	33	73.3%	12	26.7%	0	0.0%
Using Problem or Scenario Based Learning effect on	39	86.7%	6	13.3%	0	0.0%
Using Scaffolding or Instructor Support effect on	35	76.1%	10	21.7%	1	2.2%
Using Experiential learning effect on	39	84.8%	6	13.0%	1	2.2%
Using Collaborative and Cooperative Learning effect on	28	65.1%	14	32.6%	1	2.3%
Using Situational Learning effect on	43	93.5%	2	4.3%	1	2.2%
Other Learning Strategy effect on	2	100.0%	0	0.0%	0	0.0%

The effect of using digtial applications and mobile technologies with	Increase transfer of knowledge and skills to operational contexts					
	Positive Impact		No Impact		Negative Impact	
	Count	Row N %	Count	Row N %	Count	Row N %
Encouraging Self Directed Learning effect on	33	73.3%	10	22.2%	2	4.4%
Using Goal Setting effect on	25	59.5%	17	40.5%	0	0.0%
Using Problem or Scenario Based Learning effect on	37	80.4%	9	19.6%	0	0.0%
Using Scaffolding or Instructor Support effect on	29	65.9%	14	31.8%	1	2.3%
Using Experiential learning effect on	41	87.2%	6	12.8%	0	0.0%
Using Collaborative and Cooperative Learning effect on	29	65.9%	13	29.5%	2	4.5%
Using Situational Learning effect on	40	87.0%	6	13.0%	0	0.0%
Other Learning Strategy effect on	2	100.0%	0	0.0%	0	0.0%

	Make training more efficient (reducing time spent or costs of training)					
The effect of using digtial applications and mobile technologies with	Positive Impact		No Impact		Negative Impact	
	Count	Row N %	Count	Row N %	Count	Row N %
Encouraging Self Directed Learning effect on	28	63.6%	11	25.0%	5	11.4%
Using Goal Setting effect on	29	65.9%	14	31.8%	1	2.3%
Using Problem or Scenario Based Learning effect on	32	71.1%	8	17.8%	5	11.1%
Using Scaffolding or Instructor Support effect on	28	63.6%	11	25.0%	5	11.4%
Using Experiential learning effect on	33	76.7%	10	23.3%	0	0.0%
Using Collaborative and Cooperative Learning effect on	25	56.8%	14	31.8%	5	11.4%
Using Situational Learning effect on	37	82.2%	6	13.3%	2	4.4%
Other Learning Strategy effect on	2	100.0%	0	0.0%	0	0.0%

Appendix C: Decision Guide

A Practical Decision Guide for Integrating Digital Applications and Mobile Technologies into Advanced Individual Training

U.S. Army Research Institute
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Table of Contents

Introduction

Practical Decision Guide Background

The U.S. Army continually seeks innovative means to improve training, particularly in the face of rapid technological advances and increasingly challenging Soldier training requirements. A relatively new area of focus seeks to exploit emerging interactive, handheld mobile technologies and digital applications to enhance the effectiveness and efficiency of Soldier training. For example, the Connecting Soldiers to Digital Applications (CSDA) initiative sponsored and encouraged units to examine the utility of employing mobile, handheld technologies, and gaming solutions to bridge the gap between Soldier learning and training as a function of time, resources, and instructor contact ratios.

The United States Army Research Institute for the Behavioral and Social Sciences (ARI), working in collaboration with ICF International, developed the following practical decision guide for AIT commanders and training developers considering the development and integration of digital applications and handheld technologies in their training programs. This guide is based on an extensive review of published research, published reviews of training practices using these technologies, and field data collected from CSDA participants and training managers. These sources were used to identify the key factors impacting this decision process and some methods for resolving challenges to device and application integration. While this guide focuses on the integration and presentation of content in AIT, its recommendations can readily be applied to other training applications, contexts, and objectives as well. It is also important to keep in mind that while these recommendations were made for unclassified content, they can also be applied to classified training environments provided all appropriate security measures regarding content control, security access, network integration, data storage, transmission and sharing, are carefully followed.

Purpose of the Practical Decision Guide

This guide was designed to aid those who have decided that they want to employ handheld mobile devices and learning applications in their training programs. While the issues and suggestions reviewed in this guide could be of some use in initially considering these technologies as a potential training option, the decision to implement handheld mobile devices and programs is best left to individual commanders and other key decision makers with full knowledge of their available resources, funding, and unique training requirements and environments. Therefore, this guide assumes that the decision to explore employing mobile learning technologies has largely been made. Thus, its focus is on how to design, implement, and execute mobile learning options.

The purpose of this guide is to assist in identifying important information regarding how student, course, instruction, and learning environment issues affect decisions of where, when, and how to integrate digital applications and mobile technologies within AIT courses. This information has been organized into a series of Metafactors, Factors, and Subfactors levels related to key training, device, and application constructs. Metafactors reflect overarching constructs related to Training Value and Cost, Training Methods and Delivery Options, and Human and Contextual Factors. Table 1 provides an overview of each of the Metafactors and their associated Factors, and Subfactors. A glossary of terms is also provided at the end of this guide. Terms highlighted in red can be reviewed in the glossary by clicking on them.

Table 1. Decision Metafactors, Factors, and Subfactors.

Metafactors	Factors	Subfactors
Training Methods and Delivery	Application	Development; Implementation; Information representation; User Interaction; Usability; Utility-Value; Compatibility
	Training Context	Classroom; Field/Range; During Personal Time; Time required or duration or training;
	Training Content	Objectives; Content complexity; Content constancy/stability; Individual/Collective task; Resource Requirements; Training Feedback; Level of fidelity of training/assessment environment; Aided vs. unaided instruction; Inherent training risks and consequences of performance
Human and Contextual Factors	Students	Attitudes/experiences with devices/applications and readiness for self-directed learning
	Instructors	Experience/attitudes toward device; Perceived benefits to instructor
	Institutional Support	Broad-based support in Army culture: Support from Chain of Command
Hardware and Infrastructure Capabilities and Constraints	Device	Utilizing Device capabilities; Usability; Durability; Portability; Supportability; Need for Peripherals
	Networking, Security, and Implementation Issues	Networking capabilities, restrictions, and policy requirements; Device, application, and data security; Student restrictions; Device management
Overarching Factors	Device and Application Value	Supplement in-class training content; Self-development training content; Demonstration, assessment, testing; Reusability
	Device and Application Costs	Device costs; Network costs; Application development costs; Device/application maintenance costs

Organization of the Guide

This document is organized into two sections and a glossary of terms. The two sections were designed to provide different levels of detail, allowing users the ability to consider more general descriptions of issues and solutions at a Factor level and then delve into more detail for each of the Factors at the Subfactor level. Section 1 provides an upper level examination of issues and solutions at the Factor level. This section is intended to give a broad overview of information and issues to consider when

implementing handheld mobile devices and digital applications that could also be used as an initial critical consideration of key issues. Should you want to know more about a particular factor and its key issues there are hyperlinks that will provide you with more information in Section 2. Section 2 provides a more detailed examination at the more specific Subfactor level, which provides significantly more information related to the impact of the subfactors on the decision to implement a handheld mobile technology or digital application into an existing or proposed course.

Target Audience for the Guide

The target audience for this guide includes anyone interested in developing and integrating digital applications and/or handheld mobile technologies to support training, including but not limited to:

1. AIT Battalion Commanders
2. AIT Battery and Company Commanders
3. Training and course managers
4. Instructors, training developers, and instructional designers.

Use of the Guide

This guide is structured to aid the identification of key issues and potential solutions related to implementing handheld mobile technologies and digital applications into existing or proposed training courses. The guide is also structured to provide a logical, deliberate process and checklists for the user to critically examine recommendations provided from published research and to determine whether these issues and potential solutions apply to their specific training context. Users are encouraged to solicit input from others regarding how relevant these issues and potential solutions are to their unique training environments and constraints.

Use of this guide should assist decision makers in estimating and examining:

1. Potential training value and costs
2. Training application, context, and content considerations
3. Student, Instructor, and Institutional support considerations
4. Device, Networking, Security, and Implementation considerations.

Throughout the guide, each factor (Section 1) and subfactor (Section 2) are organized into an **issues** section and a **solutions** section. Where specific issues directly correspond to specific solutions, the suggested solutions are numbered corresponding to the number of the issue to make it easier to link solutions with specific issues. Issues and solutions that are more general in nature are bulleted or notated in the "considerations" section.

The guide can be used in printed and electronic formats. Hyperlinks are included in the guide for ease of locating relevant sections when viewing in electronic format.

Section 1: Metafactors and Factors Level

This section provides a high level examination of the following considerations and possible methods of resolving any challenges. This information is presented at the Metafactor and Factor level.

1. Potential training value and costs
2. Training application, context, and content considerations
3. Student, Instructor, and Institutional support considerations
4. Device, Networking, Security, and Implementation considerations.

Instructions: Use the following pages to determine if the identified issues and potential solutions are relevant at the Metafactors and Factors level. For more detail about the issues described in the factors, click on the hyperlinked term to explore related Subfactors within this guide.

Metafactors: Training Methods and Delivery

Factor: Application

Description: This factor focuses on the training application being considered for employment, its creation, its use, and the potential value gained by utilizing the application.

Issues: Issues to be considered regarding the application include:

(1) Development: This is a complex process that can be negatively impacted by a lack of technically skilled developers and/or resources, an unclear development process, or an inconsistency with Army standards.

(2) Implementation: Challenges arise in implementing the application when instructors do not effectively demonstrate the application to students or students do not properly understand the use and value of the application.

(3) Information Representation: It is critical to present material in a manner to which students are receptive (e.g., visually rich media, video, audio).

(4) User Interaction: Users interact with applications in a variety of ways, such as voice interaction, touch sensitive interaction, text entry, and visual interaction. Selecting the interaction type requires considerations of time, budget, access to advanced technologies and the ability to ensure real-world applicability for users.

(5) Usability: Applications must be user-friendly, functional, and engaging in order to effectively reach users.

(6) Utility – Value: In order to be of value, applications must deliver cost-effective and meaningful training outcomes, (e.g., performance improvement, skill acquisition).

(7) Compatibility: Applications should be developed to run equally well on multiple operating systems.

Solutions: To increase chances of successful application development and use, consider the following actions and practices associated with the above issues:

(1) Development: Ensure that identified resources and your initial development plan sufficiently clarify and address your training requirements, content focus, and established Army standards for application development.

(2) Implementation: Ensure instructors take care in fully introducing applications to students.

(3) Information Representation: Utilize rich media content, video and audio. Limit text-rich documents and PowerPoint presentations when possible; consider using a game-style approach.

(4) User Interaction: Incorporate interactive features like accelerometers and leverage other handheld device functions to improve user interaction.

(5) Usability: Ensure that the application functions properly and is user-friendly; make the application engaging.

(6) Utility – Value: Identify quantitative measures to track use, student performance/accomplishment of designed activities, frequency of function problems/outages, and repair and replacement rates to determine whether the application is cost-effective and contributing to desired training outcomes.

(7) Compatibility: Consider required operating systems and use cross-platform tools to develop applications for use across multiple operating systems; obtain appropriate licenses and factor in related costs and approval times, especially regarding any network requirements or need to establish stand-alone systems.

Metafactors: Training Methods and Delivery

Factor: Training Context

Description: This factor focuses on issues central to the training environment.

Issues:	Context can have a significant impact on training. Consider the following issues with various training contexts: (1) Classroom: Handheld mobile devices can be a source of distraction in the classroom; learners can become dependent on device memory instead of developing their own. (2) Field/Range: Environmental conditions may not be conducive to proper device use; handheld mobile devices could detract from performance during training, particularly under high-risk and dangerous situations. (3) During Personal Time: "Self-directed" learning requires a more careful program of assessment and evaluation to ensure consistency with objectives and content provided in other ways.
Solutions:	To increase chances for success in the above training contexts, apply the following practices associated with the different contexts: (1) Instructors should help determine whether and when handheld mobile device use is appropriate for the training (see Instructors factor). (2) Ensure that the devices can survive the actual training environment and that users have complete knowledge of their appropriate use and control. (3) Ensure clear and detailed instructions, guidance, and usage policy are provided and model appropriate use throughout the installation/base, so users understand how to appropriately use the devices and applications on their own time. Instructors can demonstrate the value of using the handheld device by modeling how applications and handheld devices should be used during personal time to review or learn more.

Metafactor: Training Methods and Delivery

Factor: Training Content

Description: This factor focuses on the development of training applications, including lessons learned and recommendations on how to develop applications for handheld mobile devices (e.g., expected time investments, expected barriers, application development process recommendations, etc.).

Issues: Consider the following issues related to training content:

(1) Training objectives

(2) Complexity and accessibility of the training content

(3) Content constancy/stability (e.g., rapidly changing content, outdated content, etc.)

(4) Individual/Collective nature of training tasks

(5) Training Resource Requirements

(6) Training Feedback

(7) Level of fidelity of training/assessment environment

(8) Aided vs. unaided instruction

(9) Inherent training risk and consequences of performance errors

Solutions: For the issues identified above, consult the proposed solutions based upon the item numbering:

(1) Establish specific, verifiable objectives from the operational environment.

(2) When training is complex, utilize training aids that will support trainees' learning. Story-based, game-like scenarios can be used to engage learners and allow them to practice performing to achieve complex learning objectives.

(3) Ensure content is current and software is up-to-date.

(4) Handheld mobile devices can support realistic trainings for both individual and collective tasks, if appropriate measures and developments are implemented.

(5) Handheld mobile devices can provide effective virtual training experiences when real-world equipment is not feasible.

(6) Handheld mobile device feedback must be consistent with feedback from other sources to protect against introducing confusion; student-to-student feedback can ease instructor burden.

(7) Tracking learner performance via the device can ensure learners master the fundamentals before utilizing high-fidelity simulations; training device's fidelity to the psychological and physical environment should adhere to Army standards and be consistent across multiple platforms.

(8) Digital devices can support Soldiers' self-monitoring of performance but can also be used as a training aid when properly aligned with on-the-job tasks provided that they are used appropriately and learners do not become dependent on the aid.

(9) Handheld mobile device training can serve as an effective alternative to real-life training in situations that involve dangerous settings or high risk.

Metafactor: Human and Contextual Factors

Factor: Students

Description: This factor focuses on issues related to students' use of handheld mobile devices and digital applications.

Issues:	Consider the following issues that can have an impact on student use of handheld mobile devices or digital applications: (1) Attitudes and experiences with devices and applications and readiness for self-directed learning: Individual differences among students lead to a wide variety of experiences and preferences related to mobile training, including potential aversions to using handheld mobile devices and applications, lack of necessary confidence or maturity for use, or lack of familiarity with such devices. Students either have or have not used mobile learning devices in AIT; those who have not had any prior experience may need significant training on the device and training application.
Solutions:	For the above issues, consult the solution below: (1) Provide complete training on both the device and the application; pair up individuals who are comfortable with the technology with those who are not; consider different learning orientations; establish clear guidelines, policies, and expectations regarding their use during training.

Metafactor: Human and Contextual Factors

Factor: Instructors

Description: This factor focuses on issues related to instructor attitudes, experiences, and preferences regarding the use of handheld mobile devices and digital applications in training.

Issues:	Consider the following issues related to instructors in the handheld mobile device training process: (1) Experience and Attitudes toward handheld mobile technologies: Instructors might lack experience and/or confidence with handheld mobile devices or have an aversion to using handheld mobile technologies in training. (2) Device's Role in Training: Instructors must understand the role of the device in the training and use the device to an appropriate extent.
Solutions:	For the above issues, consult the solutions below based upon the item numbering: (1) Include instructors in development of applications, train instructors on effective use of the device, and demonstrate the cost-effectiveness, efficacy, and benefits of employing these tools in training. Actual and immediate acceptance by individual instructors of these tools should not be assumed. (2) When possible, instructors should be able to use the handheld devices to • Access course resources • Facilitate social networking • Demonstrate collaborative applications • Create opportunities for enhancing feedback on the course, training application, and instructor effectiveness • Track course metrics, such as time on task or frequency of use.

Metafactor: Human and Contextual Factors

Factor: Institutional Support

Description: This factor focuses on institutional support in utilizing handheld mobile devices and applications for training.

Issues:	Consider the following issues related to institutional support for handheld mobile device training: (1) Broad-based support in the Army's training culture: The Army Learning Model and Army Learning Concept 2015 emphasize a shift toward Army-wide acceptance of a blended learning approach incorporating virtual and constructive simulations, gaming technology, and other technology-delivered instruction in training. (2) Support from the Chain of Command for using handheld mobile devices in AIT will influence the success of integration efforts.
Solutions:	For the above issues, consult the following solutions: (1) Identify the policies that will require planning, work, or coordination in order to achieve compliance. Describe how you will do so. Use the hyperlinked references above to assist in the development of the case for use of handheld mobile devices and digital applications. (2) Build a case focusing on the benefits you have identified, the specific training goals and scope of your planned employment, and a complete assessment of the projected costs. If you encounter resistance, identify potential partners within the Chain of Command who will help you usher in mobile learning and work to advocate for change.

Metafactor: Hardware and Infrastructure Capabilities and Constraints

Factor: Device

Description: This factor focuses on device-related issues to better ensure successful integration of devices and applications into AIT.

Issues:	Consider the following issues related to devices and applications: (1) Utilizing device capabilities including network connectivity, display, media presentation, peripherals may be restrictive. (2) Usability of the device including user friendliness, human factors, and associated training required for effective use of devices should be considered when designing an application. (3) Durability of the device including the toughness and ability to withstand various physical conditions (e.g., being carried in a cargo pocket while Solider runs, being dropped from 10 feet) can become problematic if not sufficiently rugged. (4) Portability of the device is important to consider. If Soldier transport of the device (closely tied to device dimensions and weight) is difficult, that can impede full use. (5) Supportability of the device (i.e., the ability and availability of resources required to support various handheld mobile devices over time, including the ability to maintain and upgrade devices) can render the device useless if not fully provided. (6) Need for peripherals, including additional peripherals to be used in conjunction with the devices to deliver training. Peripherals include device accessories such as battery packs for extended life, SIM cards, memory cards, data cables, headphones, cameras, etc.
Solutions:	For each of the above issues, consult the following solutions based on the item numbering: (1) The device should be network capable and fonts and graphics should be easy to read; eliminate unnecessary code, content, and operations. (2) The device should be easy to use and users should be trained on how to properly use the device. (3) If the device is to be used in a field environment, consider additional protective measures such as a carrying case or a screen protector. (4) Smaller devices tend to be easier to carry, but they must also fit display size requirements. (5) Provide access to networks when the Army network is restricted, and identify specific service and repair requirements, especially projected upgrade schedules, technology life-spans, and replacement options. (6) CAC-enabled devices eliminate the need for encryption. If power outlet access is limited, carefully consider the desired battery life of the device.

Metafactor: Hardware and Infrastructure Capabilities and Constraints

Factor: Networking, Security, and Implementation Issues

Description: This factor focuses on networking, security and implementation issues that are important to consider when devices will require network access and data use and transmission are involved.

Issues:	Consider the following issues related to devices and applications: (1) Networking capabilities, restrictions, and policy requirements associated with connecting and using handheld mobile devices on a network. (2) Security level of training information for a specific program of instruction or MOS to be used on handheld mobile devices. (3) Device and application security to ensure the security of both the device and the application, the ability to circumvent these security measures, and the longevity of these measures (ex. self-healing devices have the ability to remove some security safe-guards).
Solutions:	For the issues identified above, consult the proposed solutions based upon the item numbering: (1) Pay attention to the restrictions and permissions to identify how to access an appropriate network for the training. Not all applications will require network access. (2) If the training content contains information that is classified, then a mobile platform may not be the best tool. In this instance, you should consider the subfactors (a) networking capabilities, restrictions, and policy requirements, (b) device and application security, (c) student restrictions, and (d) device management. (3) Ensure device incorporates all possible security safeguards, including screen lock, remote wipe programs, encrypted data, and secure location requirements.

Section 2: Metafactors, Factors and Subfactors Worksheets

How to use Section 2 of this guide:

For each of the following Metafactors, Factors and Subfactors, the user should print out each Factor sheet and complete the checklists and other information related to identifying the most significant issues and potential challenges related to each subfactor and determine the relevancy of the solution information provided as it relates to issues and challenges.

Throughout this section, issues associated with the subfactors are identified. Where specific solutions or best practices have been identified for specific issues, the solution numbers correspond to the appropriate issue number. Thus, there may be multiple identically numbered solutions offered for a single issue. Issue numbers follow the check boxes when presented in checklist format. General issues or solutions that are not aligned with a specific one-to-one issue-to-solution system are frequently presented in bullet format.

Metafactor: Training Methods and Delivery

Factor: Application

Subfactor: Development

Description: This subfactor focuses on the development of applications, including lessons learned and recommendations on how to develop applications for handheld mobile devices (e.g., expected time investments, expected barriers, application development process recommendations, etc.).

Issues: Developing a mobile application for AIT is a complex process that can lead to less than optimal outcomes for various reasons. Check any of the following that may be applicable to your current situation to help identify potential solutions to reduce negative impacts:

☐ (1) Lack of available developers with necessary skills and experience.

☐ (2) Lack of project alignment with stakeholder expectations.

☐ (3) Lack of a clearly defined and enforced mobile software development process.

☐ (4) Lack of consistency with Army standards.

As the development process moves forward, the following additional issues should also be considered to improve potential use and application of the devices and applications:

☐ (5) The application must function on multiple operating systems (e.g., Apple, Android, and Blackberry).

☐ (6) Native application software development kits with limited cross-platform functionality and contractor developed applications with proprietary code can lead to negative impacts.

☐ (7) Applications for handheld mobile devices have unique user interface requirements.

☐ (8) A lack of application effectiveness feedback from users can limit upgrading, reducing the application's shelf life.

Solutions: To reduce negative outcomes during application development, apply the following practices associated with the issue number identified above:

(1) Obtain or train multiple developers with the skills and experience to do the job, including a project lead with proven success in developing mobile applications.

(2) Ensure active, extensive collaboration between all training stakeholders (e.g., instructional designers, technical specialists, and user population) throughout development, from requirements definition through beta testing.

(3) Implement a clearly defined software development process (e.g., agile, waterfall, iterative, etc.) addressing the entire software development lifecycle and including strong configuration management protocols that establish a change control board to direct requested modifications.

(4) Utilize templates to ensure consistency with Army standards for graphical user interfaces (GUIs) and other application characteristics.

More successful development of mobile applications for AIT can be also supported by the following practices:

(5) Utilize cross-platform development tools (such as those provided by Sencha®) and common developer programming languages, such as HTML5 and CSS to develop a mobile application that will function equally well across multiple platforms (taking into account the need to acquire licenses for such tools and the associated costs and approval times).

(6) Avoid using software development kits that have limited cross-platform functionality. If possible avoid using contractor proprietary code because when application updates are required an additional cost may be incurred or there may be limitations to how the code can be modified.

(7) Develop user interfaces for mobile applications by incorporating simplicity, optimal screen sizes, and controls that favor two-handed grips and thumb manipulation.

(8) Include a user feature that gathers student and instructor comments, which can serve as the basis for future upgrades to the application.

Metafactor: Training Methods and Delivery

Factor: Application

Subfactor: Implementation

Description: This subfactor focuses on the implementation of applications in training, including training on how to use the application and the introduction of applications to students.

Issues: The following challenges have been identified as significant barriers to the effective implementation of applications during AIT:

- ☐ (1) Instructors do not always demonstrate the applications.
- ☐ (2) Instructors do not always possess the expertise needed to provide effective device and application training to students.
- ☐ (3) Students have been given handheld mobile devices and told to learn how to use them by "playing" with them without receiving instruction.
- ☐ (4) Instructors have distributed instructional booklets to teach students how to use the applications without instructor-led training.

Solutions: Successful implementation of applications in AIT can be enhanced by taking the following actions:

(1) Ensure that instructors fully demonstrate devices and applications for students.

(2) Ensure that all instructors have received training in the use of devices and applications. For example, instructors need to receive training on how to operate applications and functionality and go beyond simple user orientation. This advanced information should provide instructors with the expertise they'll require to deliver instruction via applications and mobile devices to students. Instructor training should link course objectives to application content and suggest methods for instructors to leverage applications to meet course objectives.

(3) Do not assume that students can or will learn how to use devices and applications independently.

(4) Prevent instructors from using instructional booklets without support from instructor-led training.

Metafactor: Training Methods and Delivery

Factor: Application

Subfactor: Information Representation

Description: This subfactor focuses on how information should be presented in applications. Topics within this subfactor may include considerations for text-based vs. graphic-based vs. audio-based information presentation, the use of scaffolding, and linear vs. adaptive progression.

Issues: In order to be effective, training on mobile devices must be engaging for students, so the following should be considered:

☐ (1) Students have expressed a preference for rich media content over text documents and PowerPoint presentations.

☐ (2) Keeping text documents and PowerPoint presentations updated can be challenging.

Solutions: Implementing the following practices when developing training applications could improve student response and training effectiveness outcomes:

(1) Use more video and audio.

(1) Minimize the use of text documents and PowerPoint presentations.

(1) When including online resources, provide alternatives within the application, such as allowing the application to be stored entirely self-contained on the device, in case of unreliable network access.

(1) Training-related audio or video content can be presented as podcasts or vodcasts, which are downloadable to handheld mobile devices as well as laptop and desktop computers.

(1) Consider presenting information in the form of a game with rewards (e.g., points, medals, etc.) for engaging learning.

(2) When using text elements, incorporate tabs and hyperlinks to make them more interactive

(2) When including training content that requires frequent updating, consider developing the application to update easily by accessing external online resources (such as an Army schoolhouse's website listing all MOS critical tasks) when prompted. This will reduce the burden on the application developers to maintain and update the application for rapidly changing content, as the burden for maintaining up-to-date content falls on the producers of the Army content.

Metafactor: Training Methods and Delivery

Factor: Application

Subfactor: User Interaction

Description: This subfactor focuses on how users will interact with applications. Considerations may include the necessity of voice interaction, haptic interaction via a touch screen, text entry, visual interaction (e.g., viewing training multimedia), collaboration between students, or network interaction.

Issues: When selecting user interaction features for an AIT application, the following challenges should be considered:

☐ (1) The development of complicated applications for use in AIT can take years and cost millions of dollars.

☐ (2) Current Army training developer capabilities limit how quickly AIT applications can be developed and how sophisticated they are.

☐ (3) Users expect application quality and features, such as incorporating user movement, to match those of advanced commercial gaming and simulations.

Solutions: The following factors could lead to improved user interaction with applications developed for AIT:

(1) Tradeoffs between device costs, capabilities and training requirements should be well thought out to ensure current training needs are being addressed through cost effective devices and applications.

(2) Work with developers to understand their capabilities and explore alternative sources (e.g., contracting) to develop required applications.

(3) In some instances, incorporating user movement by integrating accelerometers (which register the motion of handheld devices), can improve training fidelity and help develop psychomotor skills, as demonstrated by game systems like the Wii®, Xbox®, and PlayStation®.

(3) When incorporating user movement, tool/system interface fidelity is crucial to preventing negative behaviors (i.e., training applications need to replicate real life conditions and processes so learners do not establish incorrect habits or learn something that would cause poor performance in the real world).

Metafactor: Training Methods and Delivery

Factor: Application

Subfactor: Usability

Description: This subfactor focuses on the user friendliness (an aspect of usability which can negatively impact user acceptance of an application) of applications and other aspects such as application functionality and user interface.

Issues: A lack of user-friendliness can result from the following factors:

☐ (1) An inability of the application to function as advertised.

☐ (2) An inaccessibility of controls and functions.

☐ (3) A slow rate of device or application operation.

☐ (4) Frequent malfunctions and crashes.

Students' motivation to use a training application can be negatively affected by the following factors:

☐ (5) Users are bored by the application.

☐ (6) There is limited or no positive reinforcement for users.

Solutions: The following practices could enhance the user-friendliness, and therefore the usability, of a mobile application developed for AIT:

(1) Ensure that the application functions properly, as demonstrated by thorough testing.

(2) Make the controls and navigation simple and intuitive.

(3) Ensure that the application executes instructions in a timely manner.

(4) Ensure that the application has been thoroughly tested and is free of frequent malfunctions and crashes.

The following practices could improve students' motivation to use applications developed for AIT:

(5) Make the application fun and entertaining.

(6) Emphasize similarities to parallel games and activities developed for commercial use.

(7) Provide rewards within the application (e.g., scores, medals, bonus points, etc.) to encourage use stimulated by competition against self and others.

Metafactor: Training Methods and Delivery

Factor: Application

Subfactor: Utility - Value

Description: This subfactor focuses on the value associated with applications, such as improved motivation of trainees, improved skill transfer to the job, reduction in errors, etc.

Issues: The following points are relevant to the demonstration of application utility:

- ☐ (1) Utility is seen as one of the most important aspects of mobile learning, as a critical factor if the degree to which the application/handheld mobile device actually improves training effectiveness and remains cost effective.
- ☐ (2) Instructors must be convinced of the training effectiveness of mobile learning applications for AIT.
- ☐ (3) Instructors must be convinced of the cost effectiveness of mobile learning applications for AIT.

Solutions: When determining the utility of mobile learning applications, the following factors should be considered:

- (1, 2) Quantifiable data is important in considering training effectiveness (e.g., whether students training with an application receive higher grades than students without).
- (1, 2) Demonstrations of training effectiveness should highlight specific capabilities designed to enhance student performance.
- (1, 3) The use of an application can lead to cost savings (e.g., reduced paper cost due to less need for paper-printed training manuals).
- (1, 3) The use of an application can reduce needed training time on equipment with limited availability; students can practice skills on an application rather than the actual equipment, thus potentially reducing overall training time and associated costs.
- (1, 3) The use of an application can reduce the risk of injury and other negative outcomes while students master potentially dangerous skills.
- (1, 3) Maximizing the use of an application throughout multiple training segments could increase the return on investment.

Metafactor: Training Methods and Delivery

Factor: Application

Subfactor: Compatibility

Description: This subfactor focuses on the compatibility of applications with one or multiple devices or operating systems.

Issues:	A challenge with developing effective applications is that there may be multiple devices used across students: ☐ (1) Depending on the specific devices available to students for AIT, applications should be developed to run equally well on multiple operating systems, such as Android, Apple, and RIM (Blackberry).
Solutions:	The following factors should be considered to better ensure the timely and cost-effective development of mobile learning applications that are compatible with multiple devices or operating systems: (1) The devices and associated operating systems available for AIT should be determined. (1) A cross-platform software development kit (SDK) and other cross-platform tools should be used to develop one application for use across multiple operating systems. (1) Appropriate enterprise/developer and distribution licenses must be obtained for the cross-platform SDK and other tools. (1) Costs and approval times must be taken into account when acquiring licenses (e.g., acquiring an enterprise license can take up to 14 months).

Metafactor: Training Methods and Delivery

Factor: Training Context

Subfactor: Classroom

Description: This subfactor focuses on the use of handheld mobile devices and training applications in the classroom.

Issues: Indicate by checking the items below which issues may be relevant when considering using handheld mobile devices in the classroom.

☐ (1) Handheld mobile devices would be a source of distraction in the classroom.

☐ (2) Learners can become dependent on the memory capacity of handheld mobile devices and fail to develop their own, internal capabilities.

☐ (3) Learners can become dependent on the device's representation capabilities (e.g., graphing, charting, image capture) instead of building their own mental models.

Solutions: The following solutions should be used to address the issues above concerning the use of handheld mobile devices and training applications in a classroom training context

(1, 2, 3) Instructors should determine when the use of handheld mobile devices is appropriate. For example, in the classroom instructors could tell students when they are allowed to use devices and when they are not. This would help to keep the students from becoming distracted by their handheld device when their attention should be focused elsewhere.

(1, 2, 3) Use of handheld mobile devices should be delayed until learners have demonstrated mastery of basic material.

(3) Instructors may require learners to demonstrate understanding independently from the handheld mobile device until they are satisfied that mastery has been achieved.

Metafactor: Training Methods and Delivery

Factor: Training Context

Subfactor: Field/Range

Description: This subfactor focuses on the use of handheld mobile devices and training applications in a field/range context.

Issues: Using handheld mobile devices during field and range training and exercises needs special consideration given these environments.

Indicate by checking the items below which issues may be relevant when considering using handheld mobile devices during field and/or range training and exercises.

☐ (1) The environmental and use conditions, including weather and student movements, may not be conducive to proper functioning and device durability, placing undue stress on these devices.

☐ (2) Use of the devices could detract from performance during field and range training particularly under dangerous situations.

Solutions: The following solutions should be used to address the issues concerning the use of handheld mobile devices and training applications in a field/range context.

(1) The purchase of inexpensive handheld mobile devices may require more rugged equipment or additional protective measures, e.g. covers, containers, etc.

(1, 2) Provide detailed instructions on where and when the use of these devices is appropriate under field and range conditions.

Metafactor: Training Methods and Delivery

Factor: Training Context

Subfactor: On Own Time

Description: This subfactor focuses on the use of handheld mobile devices and training applications in one's free time as self-development, e.g. during free time in the barracks or dead time between training sessions.

Issue:	The central issue concerning self-directed learning on one's own time is described below. ☐ (1) "Self-directed" learning requires a more-careful program of assessment and evaluation to ensure that this learning is consistent with objectives and content provided in other ways (classroom, practice, etc); students should not draw incorrect conclusions about the training content.
Solution:	The solutions that are presented below will help to learners to use applications for self-directed learning. (1) Behavior modeling by instructors and other staff in and out of the classroom is an effective mode of instruction for regarding proper device use and restrictions. (1) Training developers need to use subject matter experts and instructors during development and implementation to ensure that applications used for self-directed learning are in line with training objectives and classroom course content.

Metafactor: Training Methods and Delivery

Factor: Training Content

Subfactor: Objectives

Description: This subfactor focuses on the objectives of training based on the POI and established training goals. The focus here is determining what the training is intended to accomplish (i.e., successful trainees are those who are able to…?).

Issues: Consider the following issues related to training objectives:

☐ (1) Objectives can be expressed in vague or imprecise wording.

☐ (2) Collective tasks can be difficult to assess, given that different individuals offer different levels of commitment and expertise to task performance.

☐ (3) There can be a tendency for SMEs to specify content as objectives that had been critical in the past but over time these objectives may become automated or revised by new procedures.

Solutions: For those issues identified above, consult the proposed solutions based upon the item numbering:

(1) Objectives should be expressed as observable behaviors, with a standard of mastery and a time limit. This will support the development of mobile applications that are responsive to operational requirements.

(2) Collective job-performance tasks should be assessed both at the sub-component individual task level (for individual performance) and at the collective task level (for team performance). Careful development of the application will allow for learners to observe alignment of individual and team performance.

(3) Whenever possible, the necessity of including an instructional objective should be verified by direct observation of job performance in the field to ensure accuracy of the application. Hand-held devices support this form of data collection.

Metafactor: Training Methods and Delivery

Factor: Training Content

Subfactor: Complexity

Description: This subfactor focuses on the complexity/simplicity of content for the specific task being considered for the employment of handheld devices and digital applications.

Issues: Consider the below issues related to complexity of training content:

☐ (1) Highly complex content (e.g., detailed or counterintuitive procedures, problem-solving) requires different instructional strategies than simple information learning.

☐ (2) Students may perceive content that appears to be simple as less important than more difficult material.

☐ (3) Simple content may also be less engaging content.

Solutions: For those issues identified above, consult the proposed solutions based upon the item numbering:

(1) Highly complex tasks sometimes can be addressed by job re-engineering or the creation of job aids that can be incorporated into the application.

(2) Operational scenarios and story-based instruction, useful in conveying the importance of content that appears to be simple or trivial, can be incorporated into the application.

(3) Competitive game play can be used to increase learners' cognitive engagement with information that appears to be relatively simple or unimportant. Learners can compete with one another on carefully constructed knowledge checks and/or training metrics using the device.

Metafactor: Training Methods and Delivery

Factor: Training Content

Subfactor: Stability

Description: This subfactor focuses on the constancy and stability of the training content as it relates to a particular MOS or program of instruction (POI). For instance, rapidly changing or dynamic operational environments may require nearly continuous training content updates and easy editing capabilities.

Issues: Consider the below issues related to stability of training content:

☐ (1) Subject-matter content can become obsolete if not updated regularly.

☐ (2) Rapidly changing content, subject to frequent updates, risks factual errors.

Solutions: For those issues identified above, consult the proposed solutions based upon the item numbering:

(1) Personnel should record and consider the digital applications' original creation dates to help determine if its content is still current.

(2) To ensure stability of updates to the application, need to develop standardized development and monitoring processes that include routine, independent validation and verification of content accuracy and currency.

(2) Identify the extent of available content editing capabilities and ensure appropriate personnel have the training and software needed to edit or update the training application as needed.

Metafactor: Training Methods and Delivery

Factor: Training Content

Subfactor: Individual/Collective Tasks

Description: This subfactor focuses on whether or not the application is for individual or collective tasks.

Issues: Consider the following issues related to individual/collective tasks within the training:

- ☐ (1) Realistic training scenarios are required for training behaviors to generalize to on-the-job performance.
- ☐ (2) On-the-job performance requires team coordination.
- ☐ (3) Multi-player applications that support team-building risk losing clear focus on individuals' jobs.

Solutions: For those issues identified above, consult the proposed solutions based upon the item numbering:

(1) Handheld mobile devices support more immersive training/rehearsal scenarios than possible in classroom situations.

(2) Handheld mobile devices can support collective (i.e., "team") performance.

(3) Single-player applications may better allow learners to focus on learning their own, particular jobs.

Metafactor: Training Methods and Delivery

Factor: Training Content

Subfactor: Resources

Description: This subfactor focuses on the resource requirements (e.g., equipment or range) associated with training. As an example, training that necessitates the use of special equipment would specify this equipment as a resource requirement for effective training.

Issues: Consider the below issues related to training content resources:

- ☐ (1) Job performance tasks, especially those requiring the use of expensive, complicated, or hard-to-find equipment are hard to train in regular classrooms.
- ☐ (2) Different schools may have different sets/volumes of resources.
- ☐ (3) It is not always possible for instructors to provide each student with a full set of instructional resources.

Solutions: For those issues identified above, consult the proposed solutions based upon the item numbering:

(1) Computer-based simulations delivered on handheld mobile devices can be effective in delivering instruction when hands-on exercises with operational equipment are not feasible (e.g., when there is a shortage of equipment, or the cost of training using an application would be more efficient than using physical resources).

(2) Instructors must be permitted to tailor instructional methods to local conditions. This may be more easily accomplished using digital applications than other methods.

(3) Using a collaborative learning approach, students can share resources across applications, supporting the goal of team-building.

Metafactor: Training Methods and Delivery

Factor: Training Content

Subfactor: Training Feedback

Description: This subfactor focuses on the need to provide students feedback during training. Specifically, determining if feedback is necessary for effective training progression and/or training outcomes is crucial. If it is necessary, the next concern is determining how the feedback should be delivered (i.e., visual vs. audio, instructor vs. machine, progressively or at the end of training).

Issues: Consider the following issues related to feedback:

- ☐ (1) Training feedback from the device may not align with instructor feedback.
- ☐ (2) In large classes, it may not be possible for instructors to provide tailored feedback to each learner.
- ☐ (3) Training feedback from a device can be inconsistent with operational conditions such as noise or weather.

Solutions: For those issues identified above, consult the proposed solutions based upon the item numbering:

(1) Determine the feasibility and nature of a device to ensure consistency with instructor feedback.

(2) Student–to–student feedback across devices can ease the burden on the instructor providing feedback.

(3) Ensure that training feedback from the application is consistent with feedback from other sources.

Metafactor: Training Methods and Delivery

Factor: Training Content

Subfactor: Fidelity

Description: This subfactor focuses on the level of fidelity associated with the training environment compared to the execution of learned tasks in the practical environment. Specifically, how similar is the training environment to the real environment the task is expected to be performed in (e.g., immersive flight simulator vs. flying a plane). Fidelity could relate to mundane concepts, such as does the training environment look similar to the real world environment, or more psychological concepts, such as does the trainee experience similar reactions in the training environment as in the real environment, especially in terms of risk management and time pressures. High-fidelity is a very detailed representation, whereas low-fidelity is a less detailed representation.

Issues: Consider the following issues related to fidelity of the training/assessment environment:

- ☐ (1) Introducing high-fidelity instruction and assessment can be confusing in its detail, especially early in the curriculum, before students have experienced mastery of fundamentals.
- ☐ (2) Device design could be inconsistent with Army standards.
- ☐ (3) Implementations across multiple platforms (e.g., Apple, Android, Blackberry) may vary in how the equipment is represented.

Solutions: For those issues identified above, consult the proposed solutions based upon the item numbering:

(1) Tracking learner performance on the device can ensure that high-fidelity simulation instruction and assessment can be delayed until fundamentals have been mastered.

(2) Check to ensure device fidelity is consistent with applicable Army standards.

(3) Use development templates to ensure consistent device fidelity across multiple platforms.

Metafactor: Training Methods and Delivery

Factor: Training Content

Subfactor: Aided vs. Unaided instruction

Description: This subfactor focuses on whether training is aided or unaided. Specifically, is training delivery accompanied by a supporting training device or application? And if a supporting training device is used, how should the training device be used and what limitations need to be placed on the use of the device to prevent dependency on the training aid.

Issues: Consider the following issues related to the aided or unaided nature of the training:

☐ (1) In training aided by training support devices, learners can become overly dependent on the device, devoting more attention to using the training aid and less attention to the actual goals of instruction.

☐ (2) Training aids that dramatically differ from actual job aids can hinder transference to on-the-job performance.

☐ (3) Poorly designed user interfaces can impair performance.

Solutions: For those issues identified above, consult the proposed solutions based upon the item numbering:

(1) Incorporate knowledge checks and other performance metrics that encourage self-monitoring and reinforce established instructional goals.

(2) Software development templates and appropriate usage limitations can ensure that when the device is used as a training aid, it is properly aligned with actual job aid functionality and availability.

(3) Incorporate simplicity in the training application's design and the capabilities desired in a handheld device, with smaller screens and controls that favor two-handed grips and thumb manipulation.

Metafactor: Training Methods and Delivery

Factor: Training Content

Subfactor: Risk

Description: This subfactor focuses on whether there is any physical danger or risk associated with training and the consequences of committing an error in training. Developing applications tasks with serious/dangerous consequences if errors are made may require a higher level of fidelity than non-dangerous tasks. At a minimum, training should include an emphasis that increases the learner's perceptions of the risks involved and the consequences of inappropriate or erroneous actions/decisions.

Issues: Consider the following potential risks associated with training delivery:

☐ (1) In some job-performance tasks, there is no escape from the possibility of physical injury.

☐ (2) In operating complex equipment, or for job-performance tasks involving danger (e.g., the use of ordnance), consequences of error can be catastrophic.

Solutions: For those issues identified above, consult the proposed solutions based upon the item numbering:

(1) Device-delivered job rehearsal can be effective in imparting knowledge, skills and abilities required for job tasks that have a catastrophic consequence of error. Using handheld mobile devices learners can learn concepts and practice skills in a safe and simulated environment before practicing in more dangerous environments.

(2) Device-delivered mission rehearsal in high-fidelity simulations can be useful when learning training content with serious risk of physical injury.

Metafactor: Human and Contextual Factors

Factor: Students

Subfactor: Student general characteristics, individual differences, learning orientation attitudes toward device, experiences, and readiness for self-directed learning

Description: This subfactor focuses on the general characteristics, individual differences, and learning orientation of students in AIT. Examples of characteristics, individual differences, and learning orientations include, but are not limited to: age, self-efficacy, and goal-setting skills, respectively. In addition, this subfactor concerns AIT students' attitudes (i.e., preferences for or against a particular handheld mobile device or handheld mobile devices in general), previous experiences with handheld mobile devices (i.e., number of handheld mobile device experiences and valence of those experiences), and readiness for self-directed learning (i.e., are the students motivated to use devices and applications on their own time to enhance knowledge and skills).

Issues: Which of the following may be issues related to students' use of handheld mobile devices or digital applications? (Check all that apply.)

- ☐ (1) Aversion to use of device or applications.
- ☐ (2) Lack of motivation to learn how to properly use the device or application.
- ☐ (3) Students not mature enough to use the device for learning purposes.
- ☐ (4) Students lack confidence in using device or applications.
- ☐ (5) Negative attitude toward being responsible for the device (i.e., high value item; worried about breaking or losing it).
- ☐ (6) Students' desire for privacy and/or anonymity when using the device.
- ☐ (7) Lack of familiarity with handheld mobile devices and capabilities.

Solutions: For the issues identified above, consult the proposed solutions based upon the item numbering:

(1, 3, 4, 6, 7) Have those individuals who are good at using the device model it for others; pair up individuals who are comfortable with the technology with those who are not.

(2, 6) Help the Soldier to see the value of using the device or application during training.

(3, 7) Provide training on how and when to (and when not to) use the device during training and follow-through with any identified restrictions.

(5) Increase durability of device (e.g., screen protectors, cases).

(7) Establish clear guidelines and policies regarding privacy and security while using the device; Educate students on how to use the device appropriately; Ensure proper privacy and security controls are in place on the device (e.g., firewalls, passwords, etc.).

Metafactor: Human and Contextual Factors

Factor: Instructors

Subfactor: Experience and Attitudes toward Handheld mobile technologies

Description: This subfactor focuses on the experiences and attitudes that instructors have toward handheld mobile technologies and their use in AIT.

Issues: Check the box next to each of the following potential instructor experiences and attitudes issue identified below where the issue (or lack thereof) may present a challenge to implementing handheld mobile technologies and digital applications into the AIT course under consideration. The numbers in parentheses correspond to potential solutions to overcome any issues or challenges identified.

☐ (1) Lack of familiarity with handheld mobile devices and capabilities.

☐ (2) Lack of confidence in ability to use handheld mobile devices in training.

☐ (3) Aversion to technology due to prior experiences or lack of experience.

☐ (4) Less accustomed to using technology.

☐ (5) Fear of losing control of instruction.

☐ (6) Fear of being put in a position where students could know more through the accessibility of information.

☐ (7) Other (please specify)

_____

Solutions: The following options present solutions to the issues identified above for overcoming challenges related to instructor experience and attitudes toward handheld mobile technologies being integrated into AIT courses.

(1-7) Include instructors in the development of applications and the selection of handheld devices.

(2, 3, 6) Have a subject matter expert train instructors on how to use device and demonstrate strategies for effectively integrating the device and application into their training sessions and instructional styles.

(2, 3, 6) Have an application/training developer train instructors on how to use the training application.

(1-7) Have instructors practice with devices/applications to gain added experience. Provide training sessions and nonthreatening avenues through which they can compare experiences, interpret personal performance and progress, and identify emerging options the device and application can be used.

Metafactor: Human and Contextual Factors

Factor: Instructors

Subfactor: Device Role in Training

Description: This subfactor focuses on identifying exactly what purpose or role the handheld mobile device and application will serve during training. Examples of device roles include supplementing a lecture, as a communication device for instructors to contact student, or use as a demonstration or practice of necessary skills (i.e., a simulation).

Issues: When deciding how best to use mobile applications during AIT, keep the following points in mind:

☐ (1) Students expect the use of online resources, social networking, and collaborative tools (e.g., Blackboard Collaborate) during training.

☐ (2) A lack of user feedback can limit the development of effective upgrades to an application.

☐ (3) When students use applications during training, their performance metrics are not always retrieved and used to evaluate progress and training effectiveness.

When planning to use mobile applications instead of hands-on training with equipment, consider the following points:

☐ (4) The availability of equipment for hands-on training can be limited.

☐ (5) Practicing with mobile applications that simulate hands-on use of equipment can improve student performance with that equipment.

☐ (6) Relying too heavily on mobile applications for training can negatively impact long-term performance, as applications cannot duplicate the experience of hands-on training in every possible way.

Solutions: The following practices could help in selecting appropriate roles for mobile applications during AIT:

(1) When possible, and enabled by the application, incorporate online resources, social networking, and collaborative tools during training.

(2) Track student feedback provided via social networking and collaborative tools, then apply it to enhancing training and upgrading the application.

(3) When possible, use the application to track student performance (e.g., frequency of use, duration of self-study, areas of difficulty, etc.), then apply them to evaluating student progress, enhancing training, and upgrading the application.

To make the most of application-based training as it relates to hands-on training with equipment, consider implementing the following practices:

(4) Use applications to augment hands-on training, not replace it.

(5) Encourage students to practice with applications when they have downtime or when hands-on training is unavailable.

(6) Prepare students for the differences they will encounter between application-based and hands-on training with actual equipment (e.g., the occurrence of problems or malfunctions).

Metafactor: Human and Contextual Factors

Factor: Instructors

Subfactor: Perceived benefits to instructor

Description: This subfactor focuses on the potential benefits that instructors can expect with the use of handheld mobile devices in AIT.

Issues: Consider the following related to instructors' experience:

☐ (1) Instructors who lack familiarity with handheld mobile devices may demonstrate a lack of buy-in. Identify how many of your instructors will need to have the value of mobile learning demonstrated to them in order to buy in to the process to determine the number solutions you may need to consider.

Solutions: In order to get buy-in from the instructors you can do some or all of the following exercises. Indicate which exercises you think will be required to get buy-in from instructors:

(1) Include instructors in the development of applications and selection of content.

(1) Demonstrate benefits of increased functionality for instructors.

(1) Demonstrate ability to use networking to connect instructors and students for collaborative learning and self-directed learning.

(1) Demonstrate to instructors how the devices increase efficiency and make instruction easier for them.

(1) Demonstrate the ability of mobile learning to improve student learning.

(1) Demonstrate the cost-effectiveness of devices to instructors in terms that are meaningful to them, such as impact on training hours, workload, training flexibility, etc.

Metafactor: Human and Contextual Factors

Factor: Institutional Support

Subfactor: Broad-based support in the Army training culture

Description: This subfactor focuses on the broad-based support in the Army training culture for embracing and using handheld mobile devices in AIT or training in general.

Issues:	With the Army Learning Model and Army Learning Concept for 2015 as guidance, many units are moving toward increased use of handheld mobile devices and digital applications in training. Multiple organizations offer guidance and support for such efforts. The following links are to various organizations and documents that contain policy and other guidance that support developing and implementing mobile learning effectively. Identify the specific policies and directives that support your vision and goals.
Solutions:	This information can be consulted to assist in building a case for using devices and application and guiding implementation through best practices. (Note: some links may not remain permanent and may require additional searching to locate documentation or related information.) • TRADOC Pam 525-8-3, The U.S. Army Training Concept 2012-2020: http://www.tradoc.army.mil/tpubs/pams/tp525-8-3.pdf • SCORM: http://www.adlnet.gov/capabilities/scorm/scorm-2004-4th#tab-main • DoD Instruction (DoDI) 1322.26: Development, Management, and Delivery of Distributed Learning: http://www.dtic.mil/whs/directives/corres/pdf/132226p.pdf • Advanced Distributed Learning (ADL) Initiative: http://www.adlnet.org/ • ADL Mobile Learning Handbook: https://sites.google.com/a/adlnet.gov/mobile-learning-guide/home/ • Mobile Learning Approaches for U.S. Army Training, Research Note 2010-07, U.S. Army Research Institute for the Behavioral and Social Sciences: http://www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA528742

Metafactor: Human and Contextual Factors

Factor: Institutional Support

Subfactor: Support from Chain of Command

Description: This subfactor focuses on support from the Chain of Command for using handheld mobile devices in AIT.

Issues: Change is often met with resistance. There may be individuals from various constituencies who will resist the move to mobile learning. Which of the following may demonstrate resistance? (Check all that apply)

☐ (1) Instructors

☐ (2) Training Developers

☐ (3) School Leadership

Solutions: Identify what you believe to be the motivation behind each constituency's resistance. Review the subfactor information contained in previous guide sections related to each of the following:

(1) Instructors: **Metafactor: Human and Contextual Factors; Factor: Instructors; Subfactor: Experience and Attitudes toward Handheld mobile technologies**

(2) Training Developers - **Metafactor: Human and Contextual Factors; Factor: Institutional Support; Subfactor: Broad-based support in the Army culture**

(3) School Leadership - **Metafactor: Human and Contextual Factors; Factor: Institutional Support; Subfactor: Broad-based support in the Army culture**

(4) Other – Determine which of the areas covered in this guide may assist in reducing resistance.

You will likely have allies within the Chain of Command who will help you usher in mobile learning. Here are some additional actions you may take to improve implementation success:

- Identify the leaders and contact information of individuals within the Chain of Command who will be or could be effective advocates for change.
- Identify what you will do to unite these forces, how they can help you to affect change, and what evidence is needed to gain their support.

Metafactor: Hardware and Infrastructure Capabilities and Constraints

Factor: Device

Subfactor: Utilizing Device Capabilities

Description: This subfactor focuses on how to get the most out of device capabilities in application development. This subfactor identifies issues associated with various handheld mobile devices and application development practices that will maximize the value of device capabilities for mobile learning in AIT.

Issues: Check the box next to each of the following potential device capability issues that are identified below, where the issue (or lack thereof) may present a challenge to implementing handheld mobile technologies and digital applications into the AIT course under consideration.

- ☐ (1) Network capabilities for user collaboration
- ☐ (2) Size of visual display
- ☐ (3) User interface

Solutions: For those issues identified above, consult the proposed solutions based upon the item numbering:

(1) Select a device that is network capable (have internet access through a cell signal or through wi-fi capability). Attempt to ensure that the device should be supported by the Army's network infrastructure.

(3) Fonts and graphics should be easy to view.

(3) Pages should be carefully created to prevent scrolling in two dimensions.

(3) Unnecessary code, content, and operations should be eliminated.

(3) Efficient formats and standard color palettes for media should be used.

(3) Content should be divided into small objects for easy download.

(2) Larger screens may be preferred as they tend to be easier for Soldiers to view and use. Additionally, larger screens may be required to manage the level of information presented in complex applications and improve user interaction with applications.

(1-3) Identify the issue and consult information throughout this guide that may assist in overcoming any potential student challenge encountered.

Metafactor: Hardware and Infrastructure Capabilities and Constraints

Factor: Device

Subfactor: Device Usability

Description: This subfactor focuses on the usability of handheld mobile devices and the associated training required for effective use of devices.

Issues: Check the box next to each of the following potential device usability issues that are identified below, where the issue (or lack thereof) may present a challenge to implementing handheld mobile technologies and digital applications into the AIT course under consideration.

☐ (1) Ease of use

☐ (2) Setting for device use

Solutions: For those issues identified above, consult the proposed solutions based upon the item numbering:

(1) Instructor and student buy-in will be easier to obtain if the device is easy to use.

(2) Educate the Soldiers on how to use the device properly;

(2) Determine what usage guidelines should be implemented to minimize Soldier distraction while using the device;

(2) Determine what security safeguards should be activated (or turned off) on the device to address user restrictions.

(1-2) Identify the issue and consult information throughout this guide that may assist in overcoming any potential student challenge encountered.

Metafactor: Hardware and Infrastructure Capabilities and Constraints

Factor: Device

Subfactor: Device Durability

Description: This subfactor focuses on the toughness and ability to withstand various physical conditions of various handheld mobile devices in different AIT contexts.

Issues:	Does your current situation require a device that can be used in a field environment? ☐ (1) Yes ☐ (2) No
Solutions:	Consult the proposed solutions based upon the item numbering: (1) Consider additional protective measures for the device such as a carrying case or screen protector. (1) If additional device protection or the cost of potential damage to devices is cost prohibitive, consider limiting the use of devices to non-field conditions (e.g., classrooms, designated study areas, barracks). (2) Durability issues may not be of principal concern. Standard devices should suffice.

Metafactor: Hardware and Infrastructure Capabilities and Constraints

Factor: Device

Subfactor: Device Portability

Description: This subfactor focuses on the ease of transport of the device.

Issues: Check the box next to each of the following potential device portability issues that are identified below; where the issue (or lack thereof) may present a challenge to implementing handheld mobile technologies and digital applications into the AIT course under consideration.

☐ (1) Lightweight

☐ (2) Transportable

☐ (3) Other (please specify: _____)

Solutions: Consult the proposed solutions based upon the item numbering:

(1, 2) Smaller devices tend to be lighter and easier to carry. However, size should be balanced against the display requirements (see device capabilities).

(3) Identify the issue and consult information throughout this guide that may assist in overcoming any potential student challenge encountered.

Metafactor: Hardware and Infrastructure Capabilities and Constraints

Factor: Device

Subfactor: Device Supportability

Description: This subfactor focuses on the ability and resources required to support various handheld mobile devices over time, including the ability to maintain and upgrade devices.

Issues: Check the box next to each of the following potential device supportability issues that are identified below, where the issue (or lack thereof) may present a challenge to implementing handheld mobile technologies and digital applications into the AIT course under consideration.

☐ (1) Access to Army's network infrastructure

☐ (2) Service and repair capabilities

☐ (3) Need for upgrades

Solutions: For those issues identified above, consult the proposed solutions based upon the item numbering:

(1) When access to the Army network is restricted, an alternative solution might be to set up a private network for the device. This, of course, is dependent on available resources and capabilities.

(2) When service and repair capabilities are limited or not available for the device, service warranties might be an alternative option.

(3) Be aware of the lifecycle of the device and ensure device upgrades are compatible with older applications.

(1-3) Identify the issue and consult information throughout this guide that may assist in overcoming any potential student challenge encountered.

Metafactor: Hardware and Infrastructure Capabilities and Constraints

Factor: Device

Subfactor: Device Peripherals

Description: This subfactor focuses on the need to have additional peripherals (e.g., projector) to be used in conjunction with the devices to deliver training.

Issues: Check the box next to each of the following potential device peripheral issues that are identified below; where the issue (or lack thereof) may present a challenge to implementing handheld mobile technologies and digital applications into the AIT course under consideration.

☐ (1) CAC-access is required

☐ (2) Additional power requirements for peripherals

☐ (3) Other (please specify: _____)

Solutions: For those issues identified above, consult the proposed solutions based upon the item numbering:

(1) CAC-enabled devices eliminate the need for encryption and provide users with access to the Army's network.

(2) If access to an electrical outlet is limited, it is important to consider the battery life of the device being selected and what workarounds may be required (e.g., spare battery; guidelines for conserving power).

(3) Identify the issue and consult information throughout this guide that may assist in overcoming any potential student challenge encountered.

Metafactor: Hardware and Infrastructure Capabilities and Constraints

Factor: Networking and Security

Subfactor: Networking Capabilities, Restrictions, and Policy Requirements

Description: This subfactor focuses on the networking capabilities, restrictions, and policy requirements associated with connecting and using handheld mobile devices on a network.

Issues:

The following items are presented to determine the extent to which the mobile training in question necessitates the following networking capabilities. If you check any of these items, then you should proceed to the following question. If you do not check any items, it is likely that networking capabilities, restrictions, and policy requirements are not an issue for the training in question.

Which of the following network-requiring capabilities will be required for the handheld mobile technology or digital application being considered?

- ☐ Email
- ☐ Interactive play
- ☐ Real-time Chat (non-text message)
- ☐ Voice over Internet Protocol (VoIP)
- ☐ Video chat
- ☐ File Sharing
- ☐ Document Access
- ☐ Global Positioning System (GPS)
- ☐ Internet Access
- ☐ Other options necessitating 3G, 4G, or Wi-Fi

If you selected any of these capabilities, it seems as if the training in question necessitates network access. The following options are related to networking capabilities, restrictions, and policy requirements for the area (base) in which training is to be conducted. Policies and requirements may be different from installation to installation. Thus, these issues may or may not exist universally.

Which of the following options best describes the networking capabilities, policies, and restrictions for your implementation location? Please select only one of the following:

- ☐ (1) Handheld mobile devices are permitted to access the .mil server.
- ☐ (2) Handheld mobile devices are not permitted to access the .mil server but a private network (WiFi and/or mobile network) is currently available for handheld mobile devices.
- ☐ (3) Handheld mobile devices are not permitted to access the .mil server. A private network (WiFi and/or mobile network) is not currently available, but we are permitted to build one.
- ☐ (4) Handheld mobile devices are not permitted to access the .mil server. A private network (WiFi and/or mobile network) is not currently available. It is unknown if one can be constructed.
- ☐ (5) Handheld mobile devices are not permitted to access the .mil server. Constructing and using a private network (WiFi and/or mobile network) is not permitted.

Solutions: For the statement(s) you have identified above, consult the proposed solutions based upon the item numbering:

(1) If devices are given full access to the .mil server, training with handheld mobile devices will likely share all the access functionality and restrictions currently afforded to this network.

(2) If devices are given full access to a previously established secure or restricted network (i.e., a non-.mil network), training with handheld mobile devices may share the access functionality and restrictions currently afforded to this network.

(3) If permission has been granted to build a secure or restricted network, special attention needs to be paid to the restrictions and policies set by NEC for this network build. Further, special consideration should be given to potential time investments related to network construction.

(4) If network access is needed but not permitted, training objectives and method may have to be changed if a mobile platform is used. Alternatively, it may be the case that a handheld mobile device is not the best tool for delivering the training in question.

(5) Based on your previous responses, network access is needed for your training. At this point, it is important to determine if network access is truly needed. If network access is needed, you should be aware that attempting to negotiate with NEC to construct a private network is not always successful and has been known to take as long as 6 months. Specific policies and regulations can vary from location to location. Alternatively, it may be the case that a handheld mobile device is not the best tool for delivering the training in question.

Metafactor: Hardware and Infrastructure Capabilities and Constraints

Factor: Networking and Security

Subfactor: Device and Application Security

Description: This subfactor focuses on the security capabilities/restrictions of devices and applications. Here, the focus is on the ability to ensure the security of both the device and the application, the ability to circumvent these security measures, and the longevity of these measures (ex. self-healing devices have the ability to remove some security safe-guards).

Issues: Select all that are of concern to you regarding device and application security:

- ☐ (1) Compromise of sensitive training data.
- ☐ (2) Unintended viewing of training application by third parties or hackers.
- ☐ (3) Compromise of device specific features (e.g., hacking into GPS when GPS capability is not authorized).
- ☐ (4) Device theft.

Solutions: The following solutions may provide safe guards against the concerns identified in the previous question:

(1, 2, 3, 4) Locking access to all device content via screen lock (password enabled screen access).

(1, 3) Disable device features unnecessary for the training in questions (e.g., file sharing, Near Field Communication (NFC), GPS).

(1, 2, 3, 4) Ensure mobile tracking device is an option for your handheld mobile device.

(1, 2, 3, 4) Subscribe handheld mobile devices to programs/applications that can remotely wipe data from the device.

(1, 4) Ensure that the handheld mobile device has the ability to encrypt data.

(2) Only allow application uploads from secure locations and store applications on encrypted memory cards.

Considerations: Although these previous security options are available, they may have the following limitations:

(1, 2) Permanency of restrictions - Some security safeguards and disabled features are easily circumvented via hard restart (i.e., battery or SIM card removal) or Soldier access to system and software settings.

(3) GPS device tracking systems - Only effective if the handheld mobile device is powered on. Additionally, if the SIM card is removed, GPS device tracking systems are inoperable. These may come free with some devices, but others require payment for either an application or a subscription service.

(4) Remote Wipe - Remote wipe applications and capabilities are sometimes included with device purchase. However, some devices require the additional purchase of third-party applications to enable such a feature.

(1-4) Data encryption - Applications exist to remotely remove password protected data encryption.

Factor: Networking and Security

Subfactor: Student restrictions

Description: This subfactor focuses on the restrictions or limitations placed on AIT students as part of their training program.

Issues: Will students have access to handheld mobile devices outside of the training environment?

☐ Yes ☐ No

Solutions: If you answered 'Yes' to the previous question, the propensity for student misuse of the device is high. The following list of solutions may help to deter student misuse. If you answered 'No', these solutions may still be of relevance if student use will not be actively monitored during training.

The following solutions may provide safe-guards against the student misuse:

- Disable irrelevant features prior to delivery.
- Password-protect applications irrelevant to training using third-party application software.
- Discuss acceptable and unacceptable use with students prior to device delivery.
- Remind Soldiers of AIT communication policies and penalties (such as loss of privileges) related to misuse.
- Keep a record of phones assigned to track individual misuse behavior (such as using the phone feature on a handheld mobile device).
- Inform students of misuse safeguards.

Considerations: Although these security options are available, the following limitations and considerations may be relevant:

(1) Permanency of restrictions: Some security safeguards and disabled features are easily circumvented via hard restart (i.e., battery or SIM card removal) or Soldier access to system and software settings.

(2) If several device features normally afforded to users are disabled and training does not necessitate use of the device outside of a training environment, consider storing devices in a secure location instead of allowing students to maintain them in their possession.

Metafactor: Hardware and Infrastructure Capabilities and Constraints

Factor: Networking and Security

Subfactor: Device Management

Description: This subfactor focuses on the management of devices (e.g., how devices should be distributed, locked/secured, stored, repaired/maintained).

Issues: Is there a system in place for distributing, storing, and maintaining/upgrading devices?

☐ Yes ☐ No

Solutions: If you answered "No" to the previous question, considerations are provided to assist in creating a system for distributing, storing, and maintaining/upgrading devices. Such a system is necessary to ensure devices are not misplaced or stolen, and are maintained properly.

If you answered "Yes", a review of these considerations may improve your current system.

Distribution:

(1) Related to the potential for student misuse, consider the level of the Soldier receiving the device. Younger Soldiers may be more apt to misuse the device.

(2) Ensure that devices are labeled in some manner and can easily be tracked to the Soldier receiving the device.

(3) Prior to distribution, ensure that all unnecessary data and applications are either removed or restricted for use.

(4) Prior to distribution, ensure that all unnecessary phone features are disabled.

(5) Ensure devices currently possess the most recent firmware and operating system updates.

Storing:

(1) Devices should be stored in a secure location with restricted access.

(2) An inventory system with tracking should be created to ensure that all devices are accounted for.

Maintaining/Upgrading:

(1) Upgrade devices (i.e., firmware and operating system) together. Firmware and operating system updates may impact training applications, data encryption, and phone settings disabled for security/misuse purposes.

(2) When upgrading firmware and software, determine if information and/or software on the device should be backed up. If default settings are used and loss of applications are not a concern, a back-up may not be necessary.

(3) Whenever device firmware and/or operating system is updated, ensure the functionality of all relevant training applications.

(4) Whenever device firmware and/or operating system is updated, ensure desired security settings are in place.

Metafactor: Overarching Factors

The following overarching factors concern estimating the training value and costs associated with integrating handheld mobile technologies and digital applications into AIT. Estimating value and cost can be extremely complex endeavors and require knowledge of training effectiveness evaluation (e.g, Kirkpatrick, 1996) and return on investment calculations (e.g, Phillips, 2003).

This section is intended to provide preliminary guidance on information that is pertinent to estimating training value and costs only. Consult the above references (Kirkpatrick, 1996; Philips, 2003) for additional details on developing ROI estimates relevant for training interventions.

When estimating costs and values, use U.S. dollar approximations, if possible.

Factor: Training Value

Training value can be estimated through a number of means including student throughput, student reactions to training, student knowledge gains, student skill improvement and outcomes associated with training goals, including performance on the job. These approaches and their corresponding measures are typically done after a training program or improvement has been implemented. The following means of estimating value are intended to provide insight into the potential value of handheld mobile devices and digital applications prior to their integration into training.

Subfactor: Supplement training content

Description: This subfactor focuses on the use of handheld mobile devices to supplement training and the program of instruction for a course. As an example, blended learning strategies where handheld mobile devices are integrated with formal classroom instruction, hands-on activities, or some other form of training delivery would be considered as supplemental use of handheld mobile devices.

Where the objective of the use of the handheld mobile device and application are to supplement training content, the following means of estimating the value may be applied when other measures (see above) are not readily available.

(A) The following metrics may provide some indication of the value of digital applications in AIT. Fill in the appropriate information below:

___ Percent (out of 100%) of total course training content included in application.
___ Amount of time (in hours and fractions) student spend using the application.
___ Number of training lessons or modules included in the application.

(B) Please indicate the principal use of the application to supplement training:

_____

(C) Check either of the following that may be applicable as further evidence of the value of the handheld mobile device and associated digital applications:

☐ The application allows for additional practice on key skills not available or convenient through other means.
☐ The application allows for practicing skills that might otherwise be dangerous to practice with actual equipment.

You may wish to write up a short narrative summarizing the information presented here as evidence of the value of the handheld mobile device or application to supplementing training content.

Subfactor: Self-development training content

Description: This subfactor focuses on the use of handheld mobile devices to be used for self-development training. This factor should not be confused with unaided training, as self-development training is driven by student motivation to engage in an activity beyond what is expected for normal training purposes.

(A) The following metrics may provide some indication of the value of digital applications in AIT. Fill in the appropriate information below:

___ Percent (out of 100%) of total training content included in application for self-development.

___ Amount of time (in hours and fractions) student spend using the application for self-development.

___ Number of training lessons or modules included in the application for self-development.

(B) Check any of the following that may be applicable as further evidence of the value of the handheld mobile device and associated digital applications:

☐ The application allows for additional practice on key skills not available or convenient through other means.

☐ The application allows for practicing skills that might otherwise be dangerous to practice with actual equipment.

You may wish to write up a short narrative summarizing the information presented here as evidence of the value of the handheld mobile device or application to supplementing training content.

Subfactors: Demonstration, assessment/testing

Description: This subfactor focuses on the development of applications as a method for demonstrating (e.g., crew drills), assessing (e.g., knowledge checks), or testing (e.g., using handheld mobile devices to test student training content knowledge or skill) during learning.

Demonstration

(A) The following metrics may provide some indication of the value of digital applications in AIT. Fill in the appropriate information below:

___ Percent (out of 100%) of total training objectives included in application for demonstration purpose.

___ Amount of time (in hours and fractions) student spend using the application for demonstration purpose.

You may wish to write up a short narrative summarizing the information presented here as evidence of the value of the handheld mobile device or application to supplementing training content.

Assessment/testing

The following metrics may provide some indication of the value of digital applications in AIT. Fill in the appropriate information below:

___ Percent (out of 100%) of total training objectives that could be assessed using the application.

___ Amount of time (in hours and fractions) student spend using the application for assessment.

___ Number of training lessons or modules included in the application that could be assessed.

___ Performance on embedded knowledge checks included in the application.

You may wish to write up a short narrative summarizing the information presented here as evidence of the value of the handheld mobile device or application to supplementing training content.

Subfactor: Reusability

Description: This subfactor focuses on what aspects of mobile learning are reusable. For example, can devices be used and then returned to be used by someone else. Also, can applications be developed with templates to reuse and save on development costs.

(A) The following metrics may provide some indication of the value of digital applications in AIT. Fill in the appropriate information below:

___ Number of courses for which device could be reused without significant maintenance, modification, or upgrade.

___ Number of courses for which the application or content from the application could be reused without significant maintenance, modification, or upgrade.

___ Estimated cost savings (in dollars) involved in reusing application or content from application for other uses.

(B) You may wish to write up a short narrative summarizing the information presented here as evidence of the value of the handheld mobile device or application to supplementing training content.

Metafactor: Overarching Factor

Factor: Training Cost

To assist in making determinations regarding the possible return on investments involved in integrating handheld mobile technologies and digital applications into AIT you should attempt to gather accurate information related to the following device, application and use costs, for each of the following. When calculating costs, gather information related to initial, support, and maintenance costs.

Subfactor: Device Costs

Description: This subfactor focuses on the costs associated with purchasing a device and device accessories (including Device Peripherals).

___(in $'s) Estimated Device Total costs (including loading applications and reuse, and peripherals)

Subfactor: Network Costs

Description: This subfactor focuses on the costs associated with using or establishing a network for use with the handheld mobile devices. This could include the cost of creating a local network using WIFI, data plan costs that use SIM card capabilities to connect to a network (ex. 3G).

___(in $'s) Network costs

Subfactor: Application Costs

Description: This subfactor focuses on the costs associated with developing training applications to be used on handheld mobile devices.

___ (in $'s) Application development costs (including all costs for implementing all uses identified above under value)

Subfactor: Application Costs

Description: This subfactor focuses on the costs associated with maintaining and upgrading devices and applications. Examples of maintenance and upgrades include, but are not limited to, simple device repair (e.g., damaged screen), device operating system (OS) upgrades, application bug removal, and application upgrades intended to reflect changes in training content.

___ (in $'s) Device/Application sustainment costs (including all costs for implementing all uses identified above under value).

You may wish to write up a short narrative summarizing the cost information presented here as evidence of the cost of the handheld mobile device or application to supplementing training content. You may also wish to provide an estimate of the return on investment by translating values previously estimated into dollar figures. An ROI index can be estimated using the following formula:

$$\text{ROI \%} = \frac{\text{Total Value (\$'s)} - \text{Total Costs (\$'s)}}{\text{Total Costs (\$'s)}} \times 100\%$$

For Additional Information

For additional information regarding the Connecting Soldiers to Digital Applications (CSDA) project, please consult the following links (Note: link(s) may not be permanent and internet search may be required):

http://www.arcic.army.mil/connecting-soldiers-to-digital-applications.html

For additional information regarding the research effort in support of the development of this Practical Decision Guide, please see the similarly titled U.S. Army Research Institute Technical Report in the Defense Technical Information center (http://www.dtic.mil/dtic/).

Kirkpatrick, D. (1996). Great ideas revisited: Revisiting Kirkpatrick's four level model. *Training and Development, 50*(1), 54-58.

Phillips, J. J. (2003). *Return on investment in training and performance improvement programs*. Burlington, MA: Butterworth-Heinemann.

Glossary

Digital application

The software designed and installed on mobile devices. Applications can be designed for different objectives and using different methods. Applications designed with the purpose of training should include training methods and incorporate training methods. <return to text>

Factor

In the guide, a factor refers to a grouping or organization of considerations at a general level. Factors are used to provide information about mobile learning issues and solutions at a general level. <return to text>

Handheld mobile technology

Devices such as smartphones, tablets, or E-readers that can execute various software applications. <return to text>

Haptic interaction

The feedback that comes from a device to a user which usually consists of a force (e.g., a vibration) against the user's skin. <return to text>

Mobile learning

Involves the use of mobile, typically handheld, devices to present information for the purpose of learning. While learning takes place on mobile devices the content is usually displayed via digital applications installed on the device. <return to text>

Metafactor

In the guide, a metafactor refers to a grouping or organization of consideration at the most general level. The metafactors are best used to organize information as it requires a deeper understanding (i.e. the factor level) to begin to understand important considerations. <return to text>

Operating system

A collection of software that manages the hardware on a computer system. There are multiple mobile device operating systems, such as Android® or iOS® and the design and development of applications for each system is different. <return to text>

Podcast/Vodcast

Audio or video online media typically containing conversation or simple communication to address topical issues. <return to text>

Software Development Kit (SDK)

A grouping of software development tools typically arranged into a graphic user interface allowing for easy development of applications or software. <return to text>

Level of fidelity of training

This describes the relationship between training context and the context in the real-world when what has been trained will need to be used. High level of fidelity in training would mean that training would be very similar to the actual or real-world situation that learners would confront. <return to text>

Training developer and instructional designer

The person/people responsible for the development of content and content delivery systems, including information technology experts who are used to create applications to deliver content. <return to text>

Subfactor

In this guide, this is the most detailed and specific level of understanding and representation of the considerations related to developing and implementing mobile learning. <return to text>

SIM Card

Storage device in mobile telephones that is used to store data, applications, and other software that effects the operation of the phone. <return to text>